ANNUAL MAINTENANCE NUMBER
DECEMBER, 1940
McGraw-Hill Publishing Company, Inc. Price 35c. per copy 40c. in Canada

In This Issue
THE INDUSTRY'S LATEST MAINTENANCE METHODS

AVIATION

The Oldest American Aeronautical Magazine

Published monthly; price 25c a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y.
Subscription rates—United States, Canada, Mexico and Central American Countries, $3.00 a year; $4.00 for two years, $5.00 for three years. Great Britain and British Possessions 10 shillings per year, 20 shillings for three years. All other countries, $3.50 a year; $10.00 for three years. Entered as second-class matter September 3 1926, at the Post Office Albany N. Y. under the Act of March 3 1879. Volume 88, Number 13.

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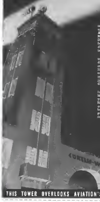

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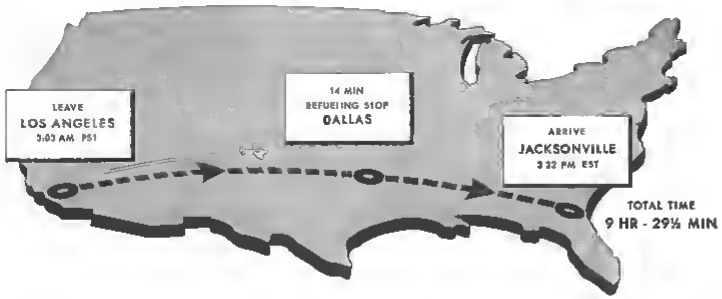

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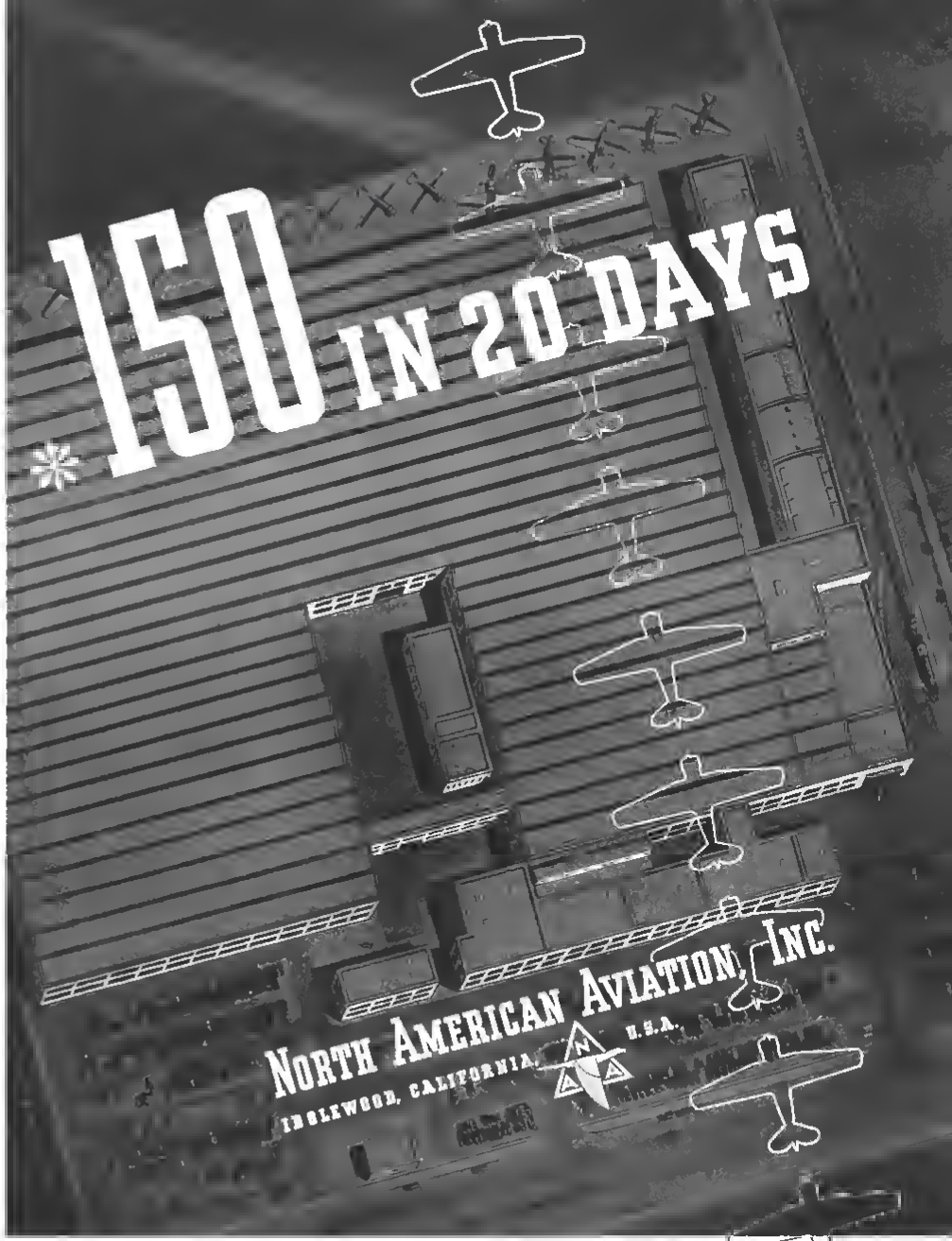

*Current average North American production in a plant which has over 20 acres under roof.

The Birdmen's Perch

Gentlemen, the world moves on. There used to be a time when solving puzzles was a sport for old ladies. But not any more—why, I've discovered you guys go after the answer to *Perch* puzzles with everything from a slide rule to an adding machine! To emphasize this trend further, this month's toughie was contributed by a Prof. from Virginia Poly! Hold your hats, boys—you're moving in fast company

Major Al Williams, alias "Tattered Wing Tips," Mgr., Gulf Aviation Products, Gulf Building, Pittsburgh, Pa.

MORE ABOUT INSIGNIA

Running this page certainly has its little problems. For instance, last month we promised that if you'd send in copies of private plane insignia we'd print the best ones. You did and we got one that stood out above all the rest. It was a picture of that furious little fellow from the movie shorts who must remain nameless but whose initials are D-D. Well, it seems 'D-D' is so tied up by copyright, etc., etc., etc., that publishing his picture is a very risky business. So—the winning entry of Mr. G. V. Stedman of Wyoming, Pa., cannot grace our page. You'll just have to imagine how good it is!

OL' WASHBOARD GOT US!

When I was a little boy, we had a colored maid who was famous throughout the neighborhood for the excellence of her laundering. How she ever got sheets, pillowcases, and shirts so snowy white was a secret she would share with no one.

However, I finally wormed it out of her one day. "Mistah Al," she told me, "here's how Ah does it. Ah washes them clo's till they's clean—an' then Ah *launders* them!"

We could apply a lot of technical names to it, but that's just about the same system we follow in refining Gulfpride Oil. We "wash" Gulfpride—and then we launder it, by means of the Alchlor Process. This *extra* step in refining, taken by Gulf, removes up to 20% more carbon and gum-forming impurities, and leaves an oil that exceeds every sec of oil specifications—including Army and Navy. So remember, when you pour Gulfpride into your engine, you're using an oil that's been "*laundered extra clean!*"

PUZZLER FROM POLY!

As you exercise your brain over this one, you can thank Mr. Edwin C. Davis, Assistant Professor of Metallurgy at Virginia Polytechnic Institute, Blacksburg, Virginia.

A man went into a shoe store and bought a pair of shoes for $6.00. In payment he gave the clerk a bogus $20.00 bill. Not having the proper change, the clerk asked the customer to wait a moment while he went across the street to the butcher's and changed the bill. Presently he returned and gave the customer his $14.00 change. A few minutes later the butcher came over and excitedly explained that the bill he had just changed for the shoe clerk was counterfeit and demanded $20.00 in good money. The manager of the shoe store gave the butcher $20.00 in good money and he went away satisfied. The question is: How much is the shoe-store manager out?

THIS MONTH'S WHOPPER

(We're still out of breath)

Dear Major:

I'm writing you to see if you will help me out of my trouble because I think you are at least partly to blame.

It all started when I built a beautiful gas model airplane, a model of your Gulfhawk. This job was complete from rudder tab to inverted flight carburetor, and quite the pride of my workshop hangar. Then Local 999¾ United Amalgamated A. & E. Mechanics and Apprentices, decided to have a hobby show and I entered my ship in the stunt plane class. My brother, a gun collector, persuaded me to mount a nifty little .22 machine gun (synchronized, of course) on the cowling and we planned to practice ground strafing before the meet.

Then along comes my cousin, a bookworm par excellence, and tells me about the claims you have been making for Gulf Aviation Gas. I tell him I don't want to monkey with my tank, GAG or no GAG, but he slips a couple of drops in with the regular model gas when I'm not looking. We arm the gun, spin the stick, and off she goes, zooming over the fence at the end of the yard.

The next thing we know, she's heading for Brainard Field. In exactly 0000000134 minutes (my uncle, a watchmaker, timed her) she's out of sight. We kiss her good-by and my cousin confesses to his dastardly deed.

Soon came a C.A.A. inspector, a Connecticut Bureau of Aeronautics officer, a state cop, a city police cruiser, and a delegation of members of the Aircraft Owners and Pilots Association. I am charged with everything to the hook.

It seems that the plane, after leaving my sight, strafed all the horses between here and Brainard (1 mile), barnstormed the hangars, caused a National Guard observer to become airsick while watching the attack, tipped the windsock from its moorings, and landed with wheels retracted on the State Capitol grounds, tipping up the Governor's pet flower bed. The police say the mechanism used to put the wheels down while the plane was ten miles from the Capitol, but the plane was going so fast that it landed before the wheels got down. The descending wheels raised the ship to a three point position, whereupon the plane walked to the nearest Good Gulf station for a refill!

I shall appreciate anything you can do to help me, Major, but please don't make me promise to use G.A.G. in my models.

Robert J. Kirkwood

Out in the open . . . .

thay were, twenty-five years ago. Both the *pilot* of this Navy Seaplane and his *control cords* . . . and he knew the name Roebling as standard equipment.

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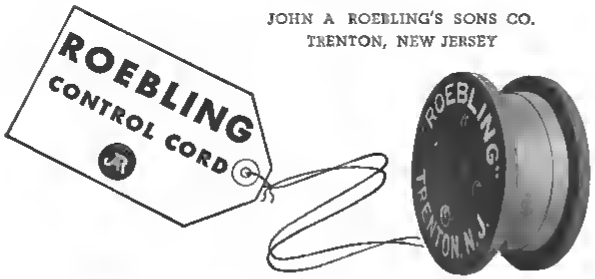
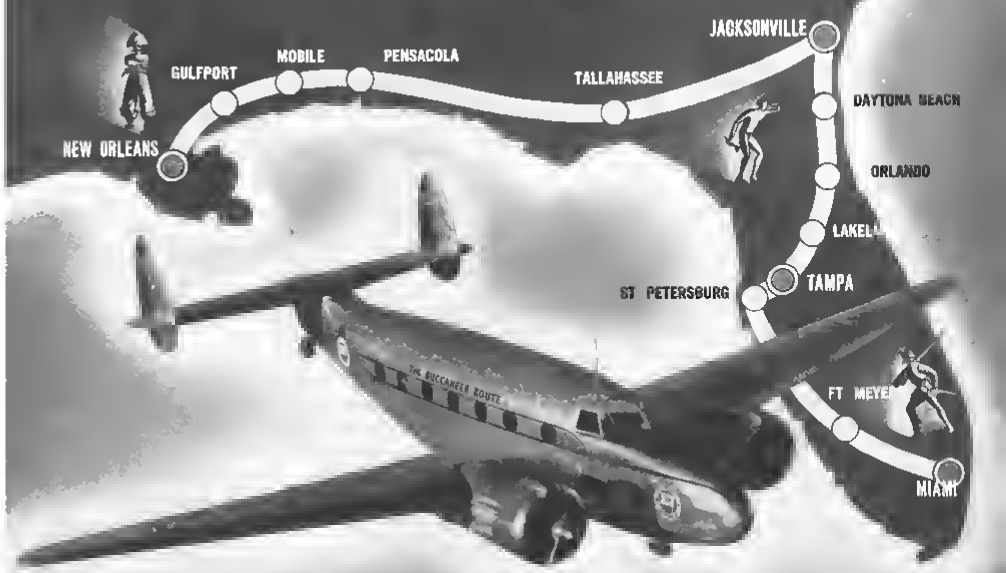


KEEPING PACE WITH AN INDUSTRY WHOSE WATCHWORD IS PROGRESS

Cyclones CRUISE THE HISTORIC *Buccaneer Route...*



NATIONAL AIRLINES' LOCKHEED LODESTARS POWERED BY WRIGHT

Spanish galleons at anchor . . . thin columns of conquistadores struggling through the Everglades in their search for the fountain of youth . . . the hideouts of Jean LaFitte and his pirate crew along the bayous of Louisiana—much of the romantic history of early America unfolds along the route of National Airlines, which links the major cities of the Florida peninsula and continues along the Gulf to New Orleans.

For augmented service over what it aptly terms "The Buccaneer Route", National is placing in service a fleet of 260 m.p.h. Lockheed Lodesters. Powered with 1200 hp. Wright G-200 Cyclones, they combine the comfort and record performance of this outstanding transport type with the long-proven reliability of the Wright Cyclone Engine.

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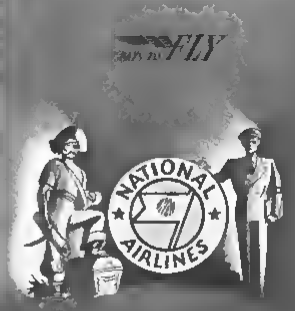

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THIS MONTH we present *Aviation's* Annual Maintenance Issue—describing private, airline and military maintenance from coast to coast

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Published monthly price 35c a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates—United States, Canada, Mexico, and Central American Countries, $5.00 a year $4.00 for two years, $3.00 for three years. Great Britain and British possessions 30 shillings per year, 60 shillings for three years. All other countries $5.00 a year $10.00 for three years. Entered as second class matter September 3, 1936 at the Post Office, Albany, New York, under the Act of March 3, 1879. Volume 20—Number 12. Printed in U. S. A. Cable address "McGrawhill New York." Member of A. B. C.

Aviation is indexed in Readers Guide to Periodical Literature and in Industrial Arts Index.

FLASHES

picked up along the editorial airways

Gold Rush Without Gold

» CALIFORNIA'S 1940 BOOM differs essentially from the gold rush of '49 in that this time there isn't any gold. And nobody knows whether or not there is going to be any. The theme song of the California manufacturers is "Where Do We Go From Here?" and nobody has the right answer. Everyone who looks beyond the end of his nose, knows that the whole industry is overexpanding and we find the curious condition of manufacturers thinking in terms of expansion and contraction at the same time. But all of them are hopeful that they will be able to develop new markets to absorb most of their new productive capacity when the need for military aircraft becomes less acute. And for the future they are seeking refuge in research and in developing commercial markets. It is a healthy sign that manufacturers are fully aware that their chief asset is their ability to create a continuously improving product.

» WIND TUNNELS ARE BEING BUILT, research laboratories planned, and commercial airplane production lines preserved insofar as possible in the scramble to double, treble or quadruple output. Northrop is the latest company to build a wind tunnel (AVIATION, *October 1940*), Lockheed and Vultee already have them. Douglas works closely with the research facilities of California Institute of Technology. Vultee is planning a new research laboratory and most of the other companies have men hard at work on new engineering projects.

» PUBLIC RELATIONS POLICIES are poles apart, ranging from good to very bad, and this is not confined to the West Coast. Not enough of the manufacturers have thought enough about public relations in their broad sense,—the relationship of their factories to their employees, their community and to the nation. Not enough thought, time, or money has been devoted to the problem of teaching the public that plane makers are not munitions makers nor merchants of death and that the chief value of the airplane is commercial and not military. Not enough thinking has been done about the social and economic problems that will arise from the attraction of large concentrations of workers to communities entirely dependent on a single factory for their existence. Once these communities of 100,000 people or more have been built, they cannot be dissolved overnight. Among the partial solutions are dispersal of plants by location and by subcontracting, unemployment reserves, research for improved products, adaptation of tooling to the manufacture of new and perhaps non-aeronautical products.

» ALTHOUGH HOLLYWOOD'S HUGE MOVIE STUDIOS are being dwarfed by the aircraft plants springing up within their midst, there is more dispersal than you think in the Los Angeles area. Distances between manufacturing centers are greater than you realize until you start to drive around to visit the plants. Inglewood, Burbank, Santa Monica, and Downey are fairly well separated and this degree of dispersal is along the same lines as that of the German aircraft industry which has proved to be a somewhat difficult target. At present the fluorescent lighted factories stand out boldly at night but provision for blackout shades is being made in the new plants and in some of the older ones.

» TO VISUALIZE THIS EXPANSION you must first throw away all old ideas about how big an aircraft factory should be. We wandered about the main Lockheed plant for half an hour before we found the original factory almost completely swallowed up by a huge radial expansion in several directions. At one point the Hudson bomber assembly line projected far out of doors and steel workers were roofing it in while final assembly went on below. Across the street a refreshment stand proprietor told us he would have to move to make way for a new building soon to be constructed. But this isn't all. Not far away a large distillery has been taken over and called by employees the "gin mill". A short distance in another direction is the new Vega factory which looks like a huge drydock under construction. Back at the central plant, 200 trained personnel workers occupy a large building and are selecting the employees for the various divisions under the unique system described in AVIATION (*January and March, 1940*). A corps of 150 special policemen (larger than the Burbank police force) guards the plants. We would have appreciated one of the many motor scooters used by some of the 14,000 employees in getting around.

» INTERNAL EXPANSION is the policy at Douglas and here greater use is made of galleries and mezzanine construction within the plant. Here too the final assembly of the DB-7 is done

out-of-doors. Inside the finishing touches are going on the B-19 and it should be wheeled out sometime after the first of the year. There is some talk of extending the Clover Field runways for it, and it sounds like a good idea. Further plant expansion is contemplated at Santa Monica and this will be augmented by the existing El Segundo Division factory and a new plant to be built at Long Beach. As this is written the Santa Monica plant has 17,500 employees and is operating on three shifts with the third shift at nearly full capacity.

» AT INGLEWOOD, North American has about 7,000 at work turning out AT-6A Trainers in increasing quantities and production is beginning to accelerate on the B-25 bomber. Expansion takes the form of completing the square made by the present L-shaped building, plus a new shadow-plant at Dallas. Not far away the new Northrop factory has been found too small and another section is under construction. Opposite the airport Interstate Aircraft & Engineering Corp. has taken time out from its well-filled schedule of parts manufacturing to design a flight airplane. We saw the first Interstate Cadet roll out of a recently completed assembly hangar. At Downey we visited Vultee on the eve of a mass delivery flight of Air Corps trainers.

» OUTDOOR ASSEMBLY of airplanes is being practiced most extensively at Consolidated in San Diego where temporary canvas-covered sheds, divided into stalls are used for finishing operations on hulls. In the yard are dozens of partially completed ships awaiting parts from subcontractors in other parts of the country. Meanwhile construction is progressing on a building larger than the present huge plant and a parts factory is planned to be built a short distance from the airport. Employment records showed 13,000 on the day of our visit.

Across the field at Ryan, production is starting on a new trainer model which has many improvements and will be described in detail in an early issue. Expansion with private funds is going on here and being written off as it progresses. The Ryan School is filled with commercial and military students and a branch primarily for Air Corps training has been established at Hemet, only a short distance from Mareb Field. We visited Solar Aircraft a short time after it had received the largest parts order in its history from an eastern manufacturer. A substantial expansion program also is under way there.

» UP AT OAKLAND we saw new Army barracks at the Boeing School. This institution has grown remarkably since our last visit. We heard of the new pilot training project at Tracy and were gratified to learn that this important step had been taken to supply much needed airline pilots. Details later.

» THERE ARE MANY interesting stories about Coast expansion. One is about the manufacturer who was lost in his new plant and had to call for a guide to help him find his way out. Another is told about a construction contractor who reported completion of a new plant and was told to start the same day on another just like it with the contract to come as soon as the

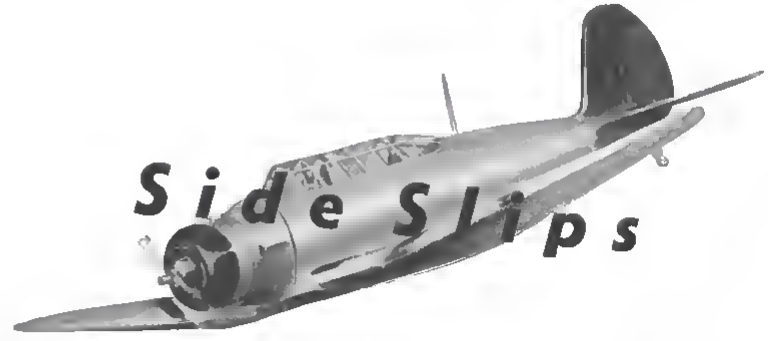
•

IT PAYS TO FLY

manufacturer had time to draw it up. But in spite of the scramble, everyone realizes that the primary purpose is to build for greater capacity for defense, and is going ahead without much thought of individual futures.

» THE PRIORITIES BOARD must realize that a subcontractor lacking sufficient tooling may hold up the production of several primary contractors and therefore immediate attention should be given to their needs. We realize the difficulty of dealing with the requirements of a large number of small organizations in a limited time and it would be well for subcontractors to organize associations to act as spokesman for them in negotiations with Washington. A step in the right direction has been taken in Los Angeles by the organization of a Parts Manufacturers Association, and this should be followed by other outside production groups.

"Poor Maguire just learned that the President wants 12,000 more airplanes!"



Side Slips

» FOUR DIFFERENT U S AIRPLANES have now been pronounced the fastest in the world. The Grumman Skyrocket, the Bell Airacobra, the Lockheed Interceptor, and the Vought fighter. Undoubtedly the British, and certainly the Germans and Italians, each have two or three fastest airplanes in the world. We wouldn't be surprised if even the Japanese have at least one.

» NO MATTER what any one else thinks, we say that the West begins at Billings, Montana. Going out West of a summer night, you leave your office in New York or somewhere in the East after a day's work. Just about dawn you come into Billings for a 20-min. stop. There, for the first time, you smell the prairie air, and if you walk out along the field border, away from the plane servicing sounds, you hear the bunch grass swishing in the soft breeze. In the gray morning you can see the dimming lights of the town down in the Yellow-

stone Valley, and away off to the South the mountains show sharp on the sky. And right over in front of the field building, on the edge of a hill, is the bronze figure of Bill Hart and his Horse. In another hour you will be over the mighty forests and the desolate plains and the 1,000-mile rivers. Dawn at Billings is one of the prettiest times of your life if your home is out West.

» AN AUTHOR WE KNOW is writing a book about the old timers in aviation who made important improvements in airplanes and who made valuable contributions to the art of flying. This author asks the question: What happened to these pioneers? Did they get their rewards? Where are they now? As you think back over the making of the airplane you recall very few outstanding names after the Wright boys. We suspect that the author will not find many. Improvements that brought the airplane to its present-day status were made over a tortuous 30 years by thousands of men. Many of them fell to their deaths in learning one little fact. Some have died of old age. You can count on the fingers of one hand the creators among them who made much money. All of them had a good time.

» ONE TIME this writer was in an airplane with Ed Allen, and saw him do something that might have foretold his present position as a foremost engineer-pilot.

Your correspondent had a big camera and was climbing around in the cold wind, shooting every which way at the Rocky Mountains. Finally he got cold and scrooched down inside out of the weather.

Did you ever have another pilot, or an instructor, ease a throttle back on you, so slowly you didn't notice it for a while? Well, Allen must have done it mighty slow, because when your shivering observer took notice, the engine was practically idling. We hadn't landed, so we must be in the air.

Quickly hoisting ourself up we were more than astonished to see the precipitous backbone of a mountain right under our left wing. There was a terrific wind driving up the slope from the valley below, and Ed was grinning with pleasure as he rode it, pretty as a buzzard. He was doing an aerodynamics research job in the field. For all we know he was plotting his future right there on that mountain side.

» THE OTHER DAY we heard a man telling something he shouldn't have been telling at all. He said that the Paramount picture people thought up a grand idea, and submitted it to the Civil Aeronautics Administration for consideration. The idea was that one of Paramount's most picturesque movie girls should be crowned "Queen of the CPTP." To prove that this girl was qualified to be queen of a large number of young men, they sent pictures of her

in all sorts of fetching poses and costumes. A lot of the men folks in CAA studied the pictures with great interest. From here on our story peters out. The Paramount proposition lay in a "pending" basket for some time and was rejected. But it must have been quite a temptation to the CAA publicity boys.

» WHATEVER BECAME of J. Monroe "Rowboat" Johnson, Assistant Secretary of Commerce, who said at Sacramento in an Aviation talk that he was "political," and the industry should remain under control of the Bureau of Air Commerce . . . of the Loening Report, which proposed that oversea aviation be administered and subsidized by the Maritime Commission . . . of Dr. Christmas, who designed some airplanes as big as barges to fly express between New York and Chicago . . . of a man in San Francisco who designed an automatic weather reporting station attached to an anchored balloon.

Aviation Photo

A major problem in the coming year will be servicing the thousands of new airplanes and engines coming off our assembly lines.

Official photograph U. S. Navy

Maintenance for 1941

BACK of every flight stands a group of men who make the flight possible. They are the service mechanics. On them, as much as on the pilots, rests the success of the flight.

There are three sides to both commercial and military aviation: building the equipment, operating it, and maintaining it. Each side of this triangle is important if the airplane and its accessories are to accomplish their purpose. Building the airplanes and flying them are much in the public eye these days. This is logical and natural. But relatively little is known outside the industry concerning the vitally important role that maintenance plays in aviation.

One of the tragedies felt by American observers in China at the beginning of the Chinese-Japanese war was the heart-breaking sight of expensive and efficient American airplanes and engines lying unused on Chinese flying fields. They could not be flown because they had not been given proper maintenance. Military planes that cannot get into the air are valueless.

Such neglect does not happen in this country. Both our military planes and our commercial ships are serviced so well that airplanes seldom wear out. They are eventually discarded because of obsolescence—not because of deterioration.

American equipment is as rugged as any in the world. Our planes abroad today are making creditable names for themselves, as has been the case for years. Original ruggedness, however, is not enough. Airplanes and engines must be given constant attention if they are to operate smoothly. This is no reflection on the manufacturer. Stresses of almost unbelievable strength operate on an airplane while it is in flight. This is especially true of fighting planes. Our engines of all sizes produce amazing horsepower for their weight. A large radial engine has from 5,000 to 7,000 separate parts. Each of its cylinders produces as much power as an entire automobile engine. To keep this complicated piece of machinery running smoothly requires the attention of maintenance experts.

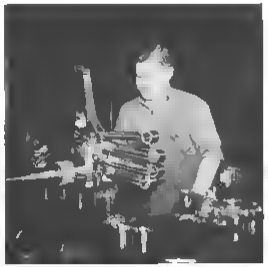
The greatest maintenance problem to be solved this year is that of the Army and Navy. Our airlines face a sufficiently difficult problem in operating one or two makes of airplane. Both the Air Corps and the Bureau of Aeronautics operate a dozen types of planes. Each must be given its own kind of servicing. Trainers are handled differently than bombers, pursuits differently than transports. Our military forces must meet the additional problem of geographical distribution. They operate planes from Alaska to Panama, from the far reaches of the Pacific to the North Atlantic coast. The freezing winters of Alaska bring one set of problems, the tropics something altogether different.

This year, with every Army and Navy field crowded with airplanes, the problem of sheer numbers of planes for which maintenance is needed adds a new element which has not been faced before. If we choose the arbitrary number of 35,000 planes, and decide that about five men are needed for each plane, (including field service and overhaul maintenance), we realize that some 175,000 trained men are needed.

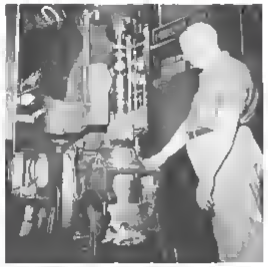
Maintenance of airline equipment and planes for all phases of civil aviation is no minor maintenance problem. The airlines are flying more transports more hours per month than ever before. At present they face a shortage of airplanes, as priority is being given to military planes in factories. The answer to this shortage may be in keeping present planes flying more hours per day by means of faster, more efficient servicing. Every airport serving private fliers is crowded. Flying schools are filled to capacity. Every ship is given regular servicing.

In this Annual Maintenance Issue the editors of *Aviation* salute the maintenance mechanic and the important division of the industry which he represents. All servicing angles are covered. Most attention is given to the military maintenance and maintenance for the private pilot because it is in these two fields that growth has been most rapid in recent months.

The pages that follow review maintenance work for the past year—and look ahead to 1941.



Daily and periodic engine inspections are made at Air Corps flying fields but major overhauls are done only at the depots. This mechanic is assembling connecting rods for a Wright engine



Hundreds of cylinders a month are disassembled, cleaned, inspected, and given a fresh start in life. Here a Barnes drill has been adapted for honing the interior of cylinder walls.

After they have gone through many steps in the overhaul process cylinders are repainted, pistons are assembled and fitted, and the cylinders are bolted to the center section of the crankcase

"Send it to the Depot—"

is the slogan of the Air Corps when time comes for major airplane or engine overhaul. With thousands of planes being added to the air force, the maintenance work of the overhaul depots takes on an added importance.

Middletown is the depot for work from 19 Air Corps fields located east of Pittsburgh and from Maine to Porto Rico. This view shows one-third of the large hangar at M.A.D.

These photographs were taken exclusively for "Aviation" at the Air Corps depot at Middletown, Pa

"POUR in gas and oil—and that's all they need!" is the comment on American planes made repeatedly in Great Britain. No airplanes in the world are built more durably and require less attention than ours. Despite their ruggedness, however, the millions of dollars worth of aircraft now owned by the Air Corps are inspected and maintained through a carefully worked out plan that has been many years in the making.

Air Corps maintenance is divided into three classifications. First, second and third echelons. First echelon maintenance is done by squadrons in the field having only the equipment they can carry, or by squadrons based at small fields where there is no base engineer and no shops to speak of. Fresh engines, wings, wheels, control surfaces and instruments are installed, but only the simplest of repairs are made. All extensive overhaul work is sent back to the depot.

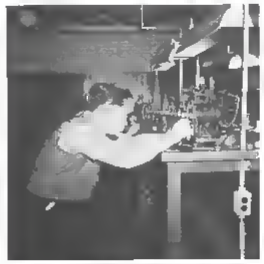
Maintenance of second echelon caliber is done at fields such as Mitchell, Langley, Selfridge and March, where machine shops, sheet metal shops and other equipment is on hand for more complex maintenance and repair work. Photographs of Mitchell Field are on pages 36 and 37

Third echelon work is done only at one of the four Air depots: Middletown Pa., Fairfield, Ohio, San Diego, Texas, or Sacramento, Calif. These four depots have the largest airplane and engine overhaul shops in this country. Each of them services over twice as many airplanes as are owned by all the airlines in America.

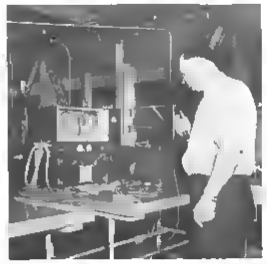
Depots are part of the Materiel Division and operate under the direction of the Field Service Section. Each depot is supervised and administered by Air Corps officers, but shop superintendents, foremen and mechanics are civilians and hold their jobs under federal civil service qualifications.

At Middletown there is an executive officer, a depot engineer officer, a depot supply officer, and a transport officer

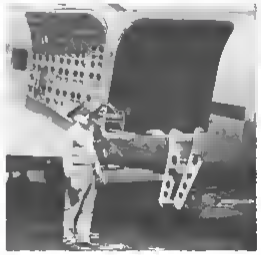
(*Turn to page 152*)



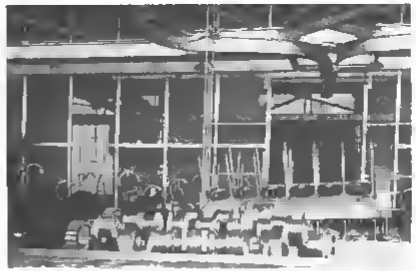
Cockpits of our fighting planes are filled with instruments. At regular intervals all instruments are routed to depots for overhaul. This instrument technician is calibrating Sperry artificial horizons.



In the accessory shop radio transmitters are tested in conjunction with an oscillogram. This is the kind of transmitter used in bombers, but all radio equipment, small and large, is checked here



Transport squadrons with Douglas cargo ships link all Army airports and depots together. This efficient freight line is invaluable to the Air Corps. Even engines and wing sections can be carried.



The engine shop already has two completely different assembly lines—for Wright and Pratt & Whitney engines. Here are the first two Allisons to reach Middletown. With the coming of this new type of liquid-cooled engine, a third assembly line has been set up. As Army equipment changes, the depot must also change.

An electric hoist, swinging down from an overhead monorail, has such delicate adjustments that this B-18 wing can be moved ¼ in. at a time. The wing is supported by cables to four lift fittings. At time of a base overhaul, wings of all ships, from trainers to bombers, are removed for a thorough inspection.

To train civilians for maintenance work a four-year apprentice course has been started. Apprentices have one hour of class work, seven of shop training per day.

MAINTENANCE AT FAIRFIELD DEPOT

At Patterson Field, Ohio, is another of the four depots which handle all major overhaul and rebuilding work for the Air Corps.

An engine and propeller hoisting stand built at Fairfield. The light but sturdy framework, the broad base and its portable features make this a flexible stand.

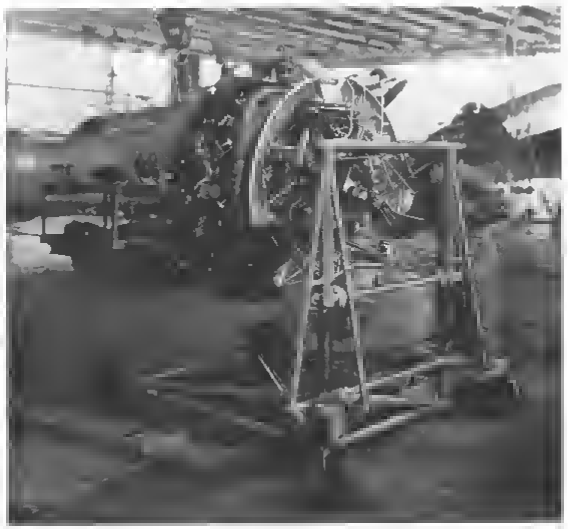
Another type of stand used for fighter work. Equipped with a hand chain hoist, this stand is ideal for hoisting the tail of a trainer or pursuit ship.

AIR CORPS maintenance is directed by the Field Service Section of the Materiel Division, with headquarters at Wright Field. In order to keep its fingers on the pulse of maintenance at all fields throughout the country, as well as at outlying Army fields, the Materiel Division has developed a system of reports on all Air Corps equipment. These are called Unsatisfactory Reports. Copies are sent both to Wright Field and to the Office Chief of Air Corps in Washington. This system of submitting unsatisfactory reports is one of the most important elements in Air Corps maintenance.

These reports enable the correction of current difficulties as they arise and provide statistical information that influences future development and design as well as changes that must be made on undelivered articles in current production.

Each unsatisfactory report is a complete description of the individual case. It describes the failure or the unsatisfactory condition of the equipment. Reports are made out by the station engineering, who adds his comments and any recommendations he has to make. He sends samples of materials or photographs with the reports.

Thus if a particular airplane part, or piece of equipment is unsatisfactory at one field it may not have much significance. But if similar conditions exist at many other fields the situation immediately assumes great importance. Engineers at Wright Field, working with base engineers at various fields and with the manufacturer can suggest design changes that remedy the difficulty. Through this system the Air Corps has steadily improved its equipment and has made valuable contributions to all aviation work in this country.



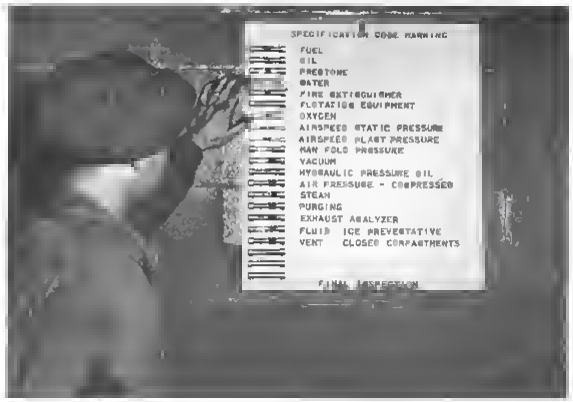
Portable engine stands of this type are used for assembling accessories after the engine has been overhauled. Rubber tired wheels add utility.

All photographs from U. S. Army Air Corps.

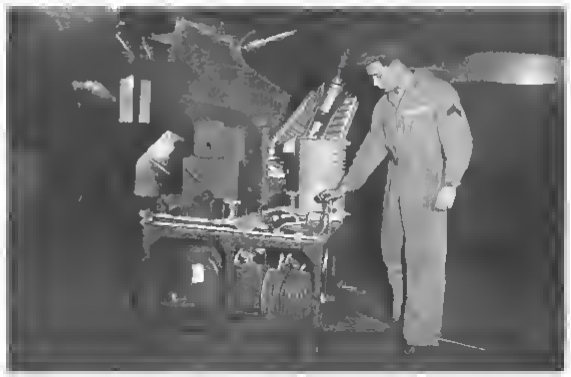
At a large depot such as Fairfield, a great deal of tubing is used. This storage rack was designed for unfinished stock.

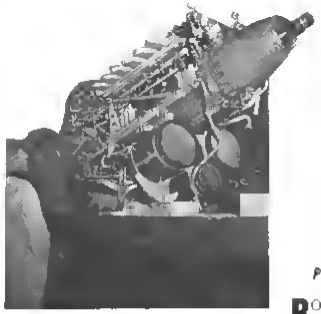
Right, a portable hydraulic test stand for testing all types of hydraulic equipment.

Below: an Army Douglas transport getting a thorough inspection. These ships are flown many hours per month and get careful attention.



To avoid confusion because of the vast amount of tubing in a large airplane, this specification code marking chart has been developed. 18 types are identified.





The first of the Allisons to arrive at Mitchell for maintenance. With this important field becoming a pursuit headquarters rather than bombardment, many liquid-cooled Allison engines will pass through the maintenance shops.

MAINTENANCE AT MITCHELL

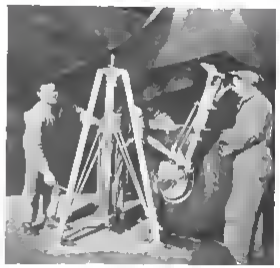
Typical of the excellent maintenance practices of the Air Corps is the work done at Mitchell Field, N. Y.

Photographs taken for Aviation.

BOTH first and second echelon maintenance are done at Mitchell Field. Squadron mechanics, assigned to a specific airplane, carry out the daily and routine inspections. They follow the airplane on its missions, keep it running smoothly, and are at home under any conditions. With the bombardment squadrons formerly stationed at Mitchell being transferred to Langley and Panama, these squadron mechanics move along with their airplanes.

Mitchell Field, however, like Langley, Selfridge, March and a few other Air Corps fields, has engine and maintenance shops which are equipped to do more complex repair work than is done by squadrons operating in the field. Major overhauls and complicated rebuilding jobs requiring much special equipment are sent back to the depot. All work here is done entirely by Air Corps officers and men.

Work done in the base engineering shops comes under the classification of second echelon maintenance.



One of the Air Corps greatest assets is its mechanics, who are well chosen and well trained. These men have lifted a Douglas B-18 bomber using a 20,000 lb. hydraulic jack developed at San Antonio.

First echelon maintenance includes the daily and routine inspections made by a group of mechanics assigned continuously to a single plane. Here a B-18 is getting an engine inspection. As Army fields fill up with airplanes, much maintenance work is done outside hangars.

Part of a 40-hr. check on another Douglas bomber. The work stand folds into a small space and is always carried in the ship. Note the open bomb doors on the lower right. Because of much special armament equipment, Air Corps mechanics have many special problems.

The field has a sheetmetal shop where repairs and rebuilding work are done. This is a handy tube bending machine designed and built at the base engineering shop at Mitchell. This type of maintenance work, for which shop equipment is needed, is classified as second echelon.

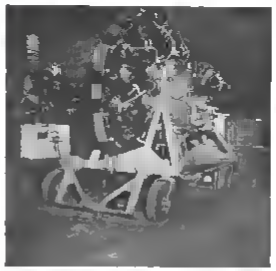
The parachute department at Mitchell Field is handled by skilled parachute riggers. Not only are 'chutes repacked at regular intervals, but silks, shroud lines, canvas covers and web harnesses are overhauled and repaired. Official Air Corps photograph.

Installing an oil cooler radiator in an engine cowling. Relatively small parts such as engine mounts and cowling are ever hauled and rebuilt at this base. Larger parts requiring special equipment are sent back to the depot for rebuilding.

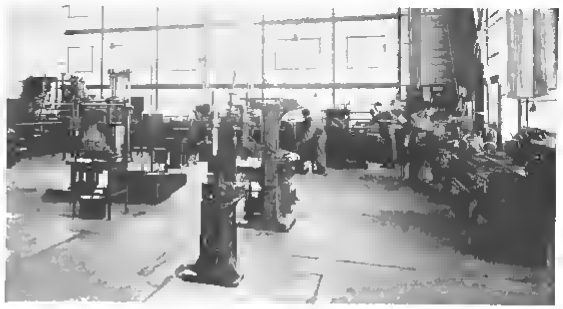
An Ingersoll-Rand Type 30 compressor for maintenance of hydraulic shock struts and other hydraulic equipment. With the booster unit on top this machine can exert pressure up to 400 lb. It is equipped with a Delco motor. Hydraulic systems play an important role in bombers.

Bomber tails are lifted with this hydraulic jack made for the Air Corps by the Black hawk Mfg. Co. When there is no weight on the jack it automatically raises half an inch off the floor and can be easily rolled about. Its flexibility and fast action make it popular.

In small ships like this BT-14 additional air is added to shock struts by hand pumps. The crew chief measures the distance between two fixed lines with a steel scale. The maintenance of this basic trainer is the responsibility of these three men.

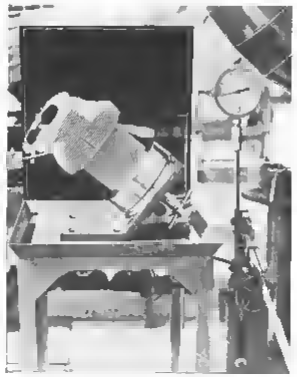


Engines are received this way from Middletown Depot. The fresh engine is bolted to this stand and the entire unit is hoisted aboard an Army Douglas transport. When engine arrives at Mitchell it is swung out of the ship and towed to the engine shop.



The machine shop, which is under the supervision of the base engineering officer. This is a well-equipped machine shop and the men working here have gone through the Army's school at Chanute Field. Many airplanes are kept in service because of rapid work done here. Official Air Corps photograph.

Official U. S. Navy photographs

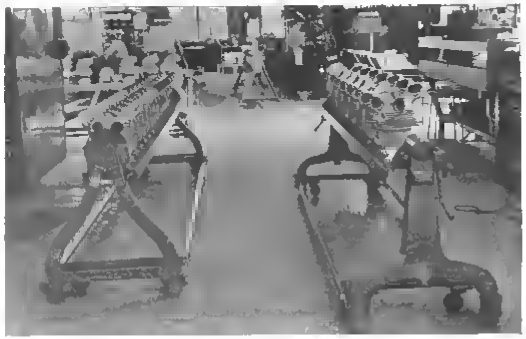


Above: During engine overhaul, cylinders are checked on this hydrostatic cylinder test fixture. Pressure, indicated on the dial is introduced into the cylinder which simulates operating pressure during flight.

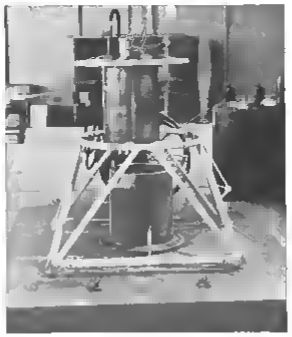
Left: this efficient stand has been built for swinging engines on and off airplanes. Each type of engine the Navy uses has its own specified time period between overhauls. When that time comes the engine is removed and put through the complete overhaul process. Fresh engines keep ships flying.

Salt Water Maintenance

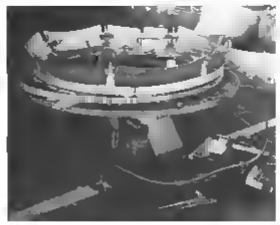
In combating salt water corrosion the Navy has one of the toughest maintenance problems in aviation. Here are pictures of the Navy's great overhaul base at San Diego



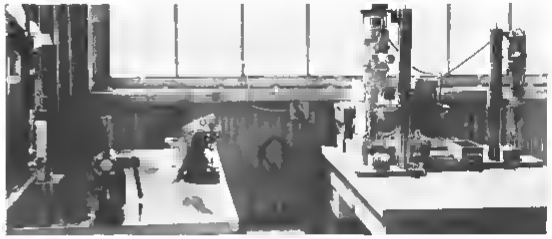
Three types of cylinder stands used in the engine overhaul shop. At the left is a Continental stand, at right a Bellys stand. In center background is a third type whose triangular frame is made from angle iron bolted together. All of these stands are portable.



Engine mounts of all sizes can be repaired and aligned in this universal jig. The fixtures on the metal base plate can be bolted in different positions for holding the mount.



In the metal shop engine cowl flaps and ring rings are overhauled on work tables like this. The table has a swivel top which makes the work more accessible and speeds up production.



In the ignition shop there is much special equipment. On the extreme left is a BG spark plug shell electrode forming tool. Next is a BG point setting tool. In the center is a BG and Aero shell electrode forming tool. On the table at the right is an Aero spark plug assembly tool, torque-clutch type (at left), and a BG assembly tool.

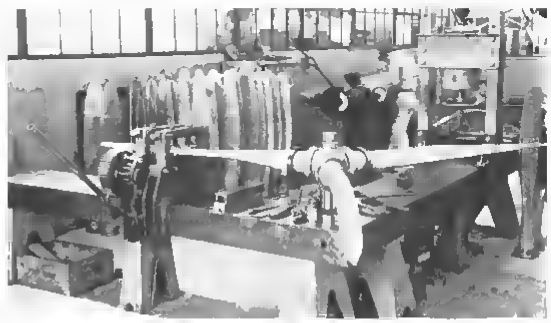
At large Naval Air Stations all maintenance and repair work is done on the field and major overhaul work is not sent back to depots as is the case in the Army Air Corps. Each Navy base has facilities for doing an all-round maintenance job, from simple work such as routine inspections and fabric patches to complex jobs such as rebuilding fuselages and large wing structures.

The station at San Diego has the Bureau of Aeronautics' largest maintenance shops. Not only are all the planes based on North Island given servicing here, but a large proportion of carrier-based aircraft and other planes attached to the fleet are brought here for major repairs and overhaul.

With new airplanes being delivered to the Navy daily, and with several thousand to arrive soon, the many specialized shops at San Diego are humming with activity. Four pages are inadequate to tell the complete story. Here are representative samples of Navy maintenance.

Shop facilities of the Naval Air Station on North Island, San Diego have been more than doubled during the

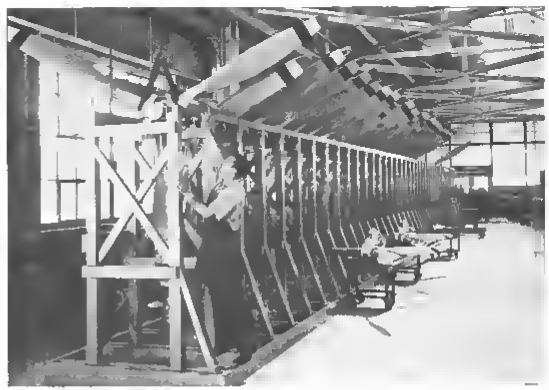
(*Turn to page* 130)



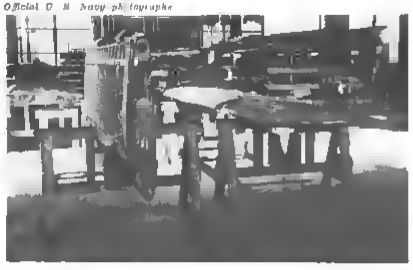
The base has a complete propeller shop, of which this is a small corner. This solidly-built L-shaped propeller table was constructed for a double purpose. With the hub firmly bolted to the center fixture blades may be twisted as shown at the left. At the right end is a 50-ton hydraulic press for straightening bent propeller blades.

After propellers are disassembled, cleaned, repaired inspected and once more reassembled, they are stored in these wooden racks until they are needed. Propellers are moved about the shops on the rubber tired dollies shown here or on overhead monorails, a glimpse of which is seen above the propellers.

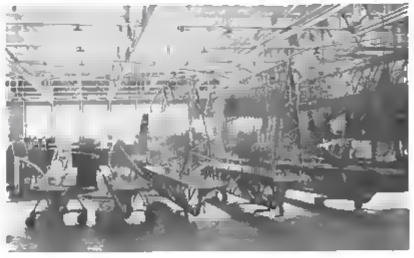
This tool for boring the bushings of articulating rods was designed at San Diego. This is work which must be done with extreme accuracy. Machine bores both bushings at the same time.



Official U. S. Navy photographs



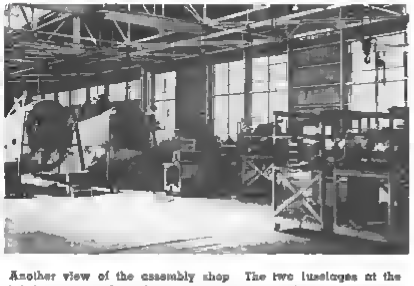
At the Naval Air Station at San Diego a great deal of wing work is necessary. These wooden horses can accommodate a wing in either vertical or horizontal position. Shelves in the background hold ribs, leading edges, wing tips and other parts.



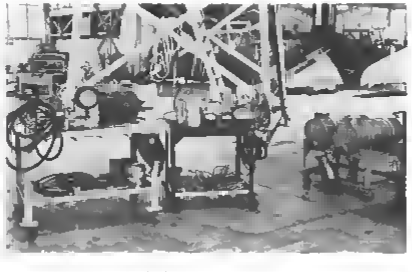
A base as large as San Diego must have equipment for the handling of many kinds of airplanes. Here are five jigs that make up a complete set for handling the trailing edges of Consolidated patrol bombers during wing overhaul.

Here is a good example of one of the many special jigs built for accommodating parts of different sizes during overhaul. This wing flap has been damaged in the upper left corner and will be repaired. Flaps of different lengths and widths are easily handled in this jig, adjustable both horizontally and vertically.

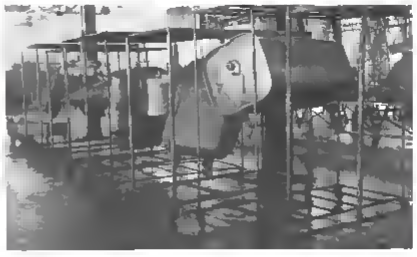
At the left is a supporting jig for a metal float that has been overhauled. In the center are two wing panels held in a double-wing dolly. The wood frame at the right holds floats of different sizes. Each horizontal support is held by a center bolt and can accommodate itself to the slope of the float.



Another view of the assembly shop. The two fuselages at the left have gone through complete overhaul and are now in the process of being built up. They are supported on the jigs at the engine mount fittings. Jigs are on movable casters so that fuselages may be pushed around the shop. Chain hoists hang from rows of monorails attached to the overhead girders. At the right are parts stands for holding work during assembly. Engines awaiting assembly are in the background.

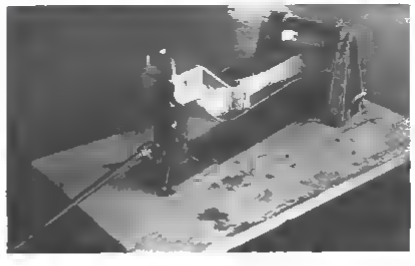


After overhaul is finished, airplanes are built up again in the assembly department. Hydraulic equipment is tested thoroughly. On the left is a portable bench for testing hydraulic equipment that is fully installed in planes. In the center is an electric pump for flushing hydraulic lines in airplanes. At the right are two small tanks which contain hydraulic fluid. The background shows the lower part of a large workstand and parts waiting assembly. A vast amount of test equipment fills these shops.

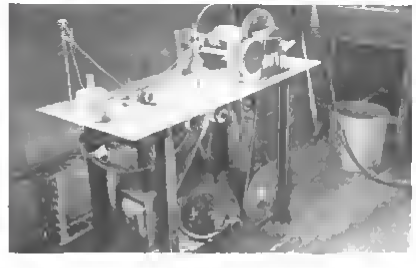


Gasoline and oil tanks are often rebuilt during the overhaul period. Then they are sent to the paint shop for fresh coats of paint. Cumbersome equipment is easily moved about the shops on these conveyor stands.

Thousands of yards of airplane fabric per year are used for covering planes. Fabric is laid out and cut on these smooth top tables. Rolls are held in the slots under the table top and fabric can be easily pulled out for use.



In the Interim Overhaul Shop are a number of these strong lifting jacks for use with the PBY flying boats. The jack is swivelled at the rear end so that it may be used on ground that is not level. The weight is borne to the circular lifting weldment in the center of the frame.



This Rube Goldberg gadget was designed at San Diego to wax thread and cord for the fabric shop. The motor below turns the drum at the right, thus drawing the thread through a waxing pad mounted on the table top. A level-winding device works on a fishing reel principle, winding thread evenly.

Dozens of trucks like these go humming up and down the ramps and aprons at San Diego carrying equipment and towing ships. At the extreme left are trucks with cranes which are used for hoisting engines, propellers and other equipment. At the right end of the line are a number of float wagons which are pushed out into the water and lifted in place under the floats of sea planes, facilitating removal of the planes from the water. Every hangar on the field is filled with equipment, as shown.

The emphasis in these photographs has been on equipment rather than on the men who perform the work. The personnel at the station are of the highest type that can be found. Approximately one-third of the mechanics are enlisted men of the Navy, many of whom are under training for subsequent work on airplane maintenance with the fleet. The balance is made up of civilians who have passed civil service examinations, having previously had special aviation training or experience.

NAVAL RESERVE MAINTENANCE

Standards are high and equipment is complete at the Reserve Aviation Bases throughout the country. Work at the Floyd Bennett Base is representative of Navy efficiency.

Aviation photographs

The base has a small but complete instrument shop. This is an altimeter tester designed and built by the Naval Aircraft Factory. Air pressure in the chamber simulates various altitudes. Overhauled instrument must check with an altimeter in the chamber that is known to be ok.

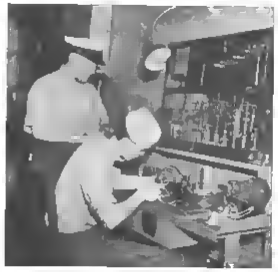
MAINTENANCE at a Naval Reserve Aviation Base has its foundation on a series of inspections which are rigidly outlined and which are followed minutely. Before any airplane is flown 59 items are covered in the daily flight inspection. These points of the airplane and engine are covered every day the airplane flies. After 10 hr. of flying the plane is put through a 10-hr check. Following 20 hr in the air the inspection covers all the daily items, all the 10-hr checks plus new items.

The 20-hr inspection covers 82 points, divided among the following parts: propeller, engine, fuel system, lubricating system, electrical system, wings, tail, landing gear, fuselage and controls. At the 30-hr inspection a total of 104 points are covered as well as those covered in the 10-hr check. The 40-hr inspection and the 60-hr check include new points not covered previously.

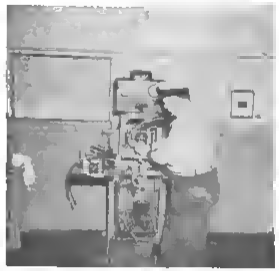
After 120 hr the inspection covers all previous points plus seven more. There are monthly checks regardless of the amount of flying time the airplane has had which cover flotation bags and such equipment as fire extinguishers. Four times a year there is a quarterly overhaul and twice a year there is a semi-annual inspection. After a specified period, which depends on the type of airplane and the service in which it is engaged, the plane and engine are put through a major overhaul. This is know as "the works" and the Navy mechanics do not miss a single rivet in their inspections.

Thus the Navy keeps its airplanes, engines and other flying accessories in as nearly perfect condition as is possible. Navy planes have long lives and taxpayers get full value received.

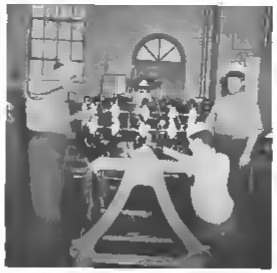
A Navy mechanic using a Black & Decker Vibro-Centric kit for reboring valve seats in a cylinder. A wood post mounted on each skin of the stand holds cylinders waiting for servicing or assembly.



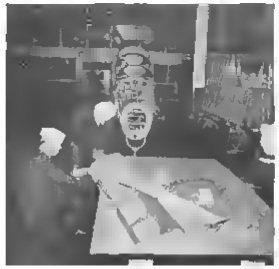
Overhauling a Scintilla magneto for a P & W twin-row engine. The tool box on the wall is made by Scintilla, and the top half hinges down and can be locked when tools are not being used.



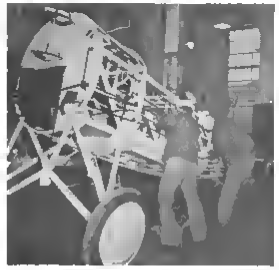
An Allen universal test stand for checking Scintilla magnetos. On the left of the stand is an a.c. Scintilla ampere meter. All engine accessories are completely disassembled at major overhaul.



Tightening hose clamps and installing ignition harness on a P & W twin-row engine during assembly after overhaul. This base has complete equipment, including Magnaflux, for overhaul and inspection of engine parts.

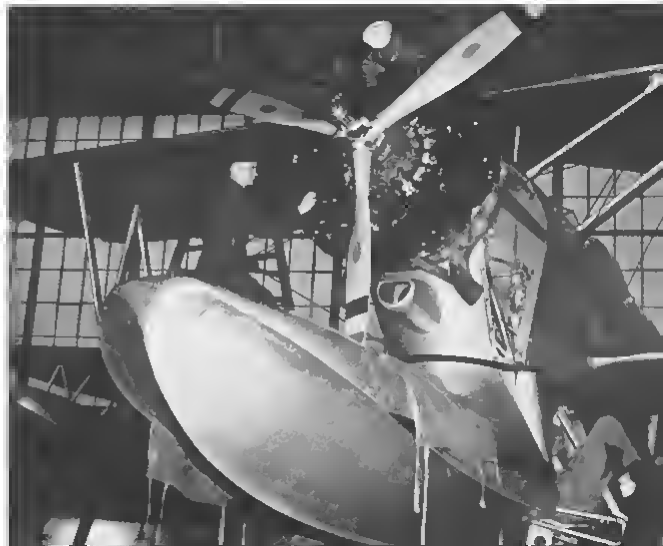


In the fuselage and wing shop all fabric covers are removed during major overhaul. These mechanics are preparing to cover an aileron with new fabric. At the right are wings from a trainer that have been uncovered for inspection.



An N2N-1 Navy trainer that has gone through a major overhaul. This ship had 850 hr. in the air since its previous major. Under the direction of skilled foremen, every part and fitting is carefully inspected. Many parts will be rebuilt.

Above, a section of the sheetmetal shop with a cutter and rolls on the rear table. Completely new cowling and skin sections are made here and damaged members repaired. Right, making a 30-hr check on a Grumman "Duck." During the 30 hr inspection 104 major airplane and engine items are covered.



4-Engine Overhaul Era

With the inauguration of 4-engine, supercharged airplanes, new problems arrive for the maintenance man to solve.

By William Maxfield *Superintendent of Maintenance, TWA*

EFFICIENCY and economy in airline maintenance work depends to a large extent upon the successful correlation of all duties to create a steady routine and turn-over in aircraft and engine work.

Picture, then the situation a year ago in the maintenance department of Transcontinental and Western Air, Inc., when it was announced that the airline was purchasing five 307-B Boeing Stratoliners, which were equipped with new devices never before used on transport planes including a cabin supercharging system, autosyn instruments, retractable tail wheel, electrically operated flaps and two-speed superchargers on the engines.

For five years, TWA had been operating with Douglas equipment exclusively, and the maintenance work on the DC-2, DC-3 and SDT models had been organized to the point where inspection and overhaul had reached an ultimate in smoothness.

But within a few months the entire maintenance department was to be equipped and personnel trained to take charge of the big four-engine planes when they arrived from Boeing's plant at Seattle.

Starting from scratch, without benefit of precedent because no domestic airline had yet flown four-engine planes on regular schedules, the first step was to organize a program that would dovetail Douglas and Boeing maintenance as much as possible.

Mechanical and maintenance personnel spent months in Seattle, while the Stratoliners were in the final stage of construction, to familiarize themselves with every detail of the planes. As a result of their studies a maintenance manual was prepared and placed in the hands of all personnel concerned before the delivery of the first ship.

A third member of the flying crew—the flight engineer—was to be added for flights of the four-engine planes, and it was decided that the position would be filled by non-flying mechanical experts to be selected from mechanic personnel within the company who held both airplane and engine certificates of competency. Two years before delivery of the Stratoliners a correspondence course was prepared and given to all interested and qualified personnel. Those qualifying with highest grades were called to Kansas City for interviews and 18 were selected for further schooling and flight duty.

After completion of the ground course, the flight engineers and their supervisors visited all stations to give lectures and answer questions concerning the Stratoliners. In addition, all maintenance supervisory personnel from outside stations were sent to Kansas City for instruction. By the time the first Boeing plane was delivered to Kansas City the maintenance department was completely schooled.

During the pilot and field checkout program, before actual schedule service began, the maintenance department became thoroughly familiar with the ships and during the same period all flight engineers were checked out with a minimum of 20 hours actual flying time.

To synchronize Boeing and Douglas equipment special platforms, jacks, ladders and towing apparatus were designed not only for maintenance work but also for loading and servicing on scheduled flights.

The Douglas carries mail, express and baggage in front and rear compartments and the Boeing Stratoliner carries its cargo in belly compartments. One of two belly hatchways in the Boeing is used for a crew entrance to the control room while Douglas crews enter either through the passengers' cabin door or through a small baggage door in the nose. These belly entrances required a special low platform of an entirely new design.

The loading steps used on the Douglas planes could be utilized for the Boeings by adding two steps and lengthening the handrails. The two extra steps can be retracted when the platform is used for Douglas passengers.

For maintenance work in the hangars, workstands that were suitable for the tri-motor Douglas models had to be extended to accommodate the Boeing's outboard engines. New facilities for hoisting the Boeing also had to be provided since the plane weighs 30,000 pounds empty compared to the Douglas DC-3 empty weight of 16,228 pounds and regular overhead hoists could not be used. Special heavy duty jacks were therefore necessary.

Larger battery carts, designed to accommodate 24-volt batteries, also were necessary. Fuel trucks were altered to provide two hose lines in order that both left and right wing tanks could be filled simultaneously. Because the Boeing plane carries a gas load of 1,700 gallons two gas trucks otherwise would have been necessary to prevent schedule delays. New wing mats and wing ladders were designed because Stratoliner wings are higher and wider than those on a Douglas plane.

It was learned that the large size of the Boeing passenger cabins required servicing by two air conditioner trucks in excessively hot or cold weather. The heated or cooled air, enters through two vents in the right rear of the plane directly into overhead ventilator ducts.

The Boeing wheels weigh approximately 400 pounds each and cannot be handled by hand so a special dolly was designed that carries the wheel upright and can be adjusted up or down so the wheel can be placed on its axle directly from the dolly.

For work on the vertical stabilizer, which is 20 ft. 9 in. high, a special trestle has to be assembled each time a Stratoliner goes into the hangar. Due to the size of the trestle, it was not designed for permanent use and is disassembled when not in use.

Differences in actual operating parts of the Boeing and the Douglases also came in for a thorough study for maintenance purposes. Hydraulic power activates most of the movable controls on a Douglas while electricity is the Boeings' principal power agent. This includes landing flaps and landing gear.

Because of the extensive use of electricity the Boeings utilize two heavy duty 24-volt batteries compared to two 12-volt batteries for the Douglas planes.

Entirely new in design and principle was the cabin supercharging system on the Stratoliners, which makes possible the high altitude flights from 16,000 to 20,000 feet. The supercharging, or "altitude conditioning" system increases the density of the air in order to hold the cabin altitude between 8,000 and 12,000 feet although the plane actually may rise to 18,000 or 20,000 feet. It was learned that the air, when subjected to the compression of the supercharger would increase about 37 degrees in temperature and a method of cooling the air was necessary. A satisfactory intercooler system was then devised. The intake for the supercharging system is in each wing and another intake was drilled in the wings several inches from the supercharging intake. This second hole opened to another duct that extends past the part of the supercharger that compresses the air.

(*Turn to page* 130)

MAINTENANCE AT LA GUARDIA

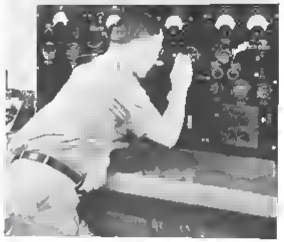
At the world's busiest commercial airport maintenance goes on 24 hours a day as hundreds of mechanics keep our transports running smoothly.

The Boeing Clippers are so large that Pan American had to build special work stands so mechanics could service engines

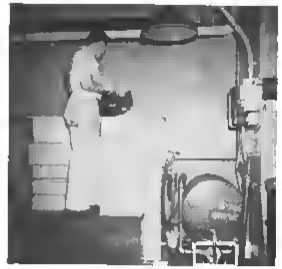
Right: American Airlines mechanics swing a Wright engine, complete with propeller, to a Douglas during an engine change.

Below: All hangars at La Guardia are in the super-colossal classification. Even TWA's Stratoliner fits easily into one corner of a TWA hangar during inspection.

The day maintenance crew of Eastern Air Lines. They service EAL planes in New York



After overhaul electrical instruments are tested here by American Airlines.

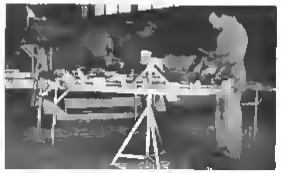


In TWA's engine shop is this new Rex de-greaser made by Circo Products Co.

Above: When any of the four engines is being tested, mechanics on the ground communicate to the cabin by means of a special telephone. Clippers are moved into the PAA hangar on a marine railway

Below: In the huge United hangar there is much special equipment for checking Mainliners after a trip across the country. This Douglas is undergoing a routine inspection before it heads for the West.

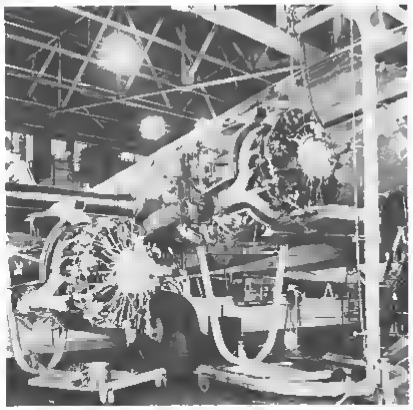
A 3,000-lb. electric crane made by the Automatic Transportation Co. for handling TWA engines and propellers.



Engine cowling for the Boeing Clippers is built up on PAA's circular stands.

Along the front of each hangar is ex cellent space for specialized overhaul shops. This is TWA's sheetmetal shop.

AIRLINE MAINTENANCE

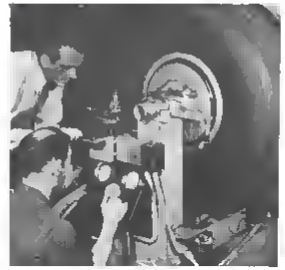


Up at St. Paul Minnesota Northwest Airlines has a splendidly equipped overhaul base. This shows a Douglas undergoing an engine change. Supported by a chain hoist on the arm of a portable crane, the engine on the right is being lowered to an engine stand. On the left is a fresh engine in another stand which will be swung into place.

Northwest has winter problems experienced by no other line except Trans-Canada. Maintenance men have had to solve many difficulties to keep their equipment in operating condition. This is an oil-burning engine and cabin heater used by Northwest which has proven to be very effective. Two pipes run to the engines, the center pipe to the cabin.

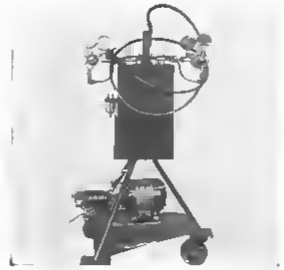
Inland Air Lines, with headquarters and maintenance base at Cheyenne runs an efficient system. The fleet of Boeing 247 Ds is kept in top flight condition. This shows a section of the large hangar with maintenance work going on at the far end.

THROUGHOUT THE COUNTRY



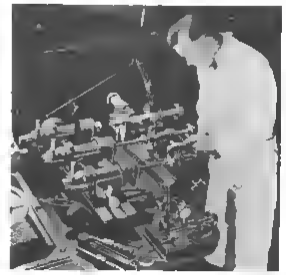
Testing wheel and brake installation at Braniff Airways' overhaul base. A large heavily loaded transport coming in for a fast landing must depend on its brakes for quick but smooth stops.

Braniff Airways has developed a highly commendable apprentice training system. This apprentice is learning instrument work under the direction of the foreman.



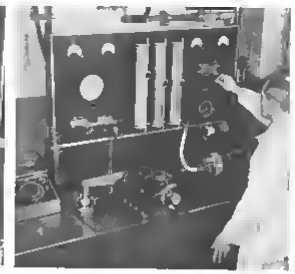
A Braniff line-service test cart for calibration of Cambridge Fuel Analyzers. Below is vacuum pump for adjusting vacuum regulators.

A Weston electrical temperature bulb tester, built by Braniff and used by mechanics for the test of all electrical temperature bulbs.

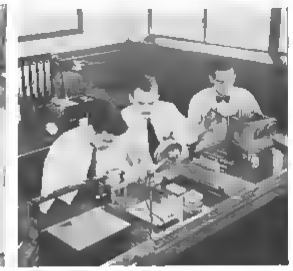


A Trans Canada machine for reaming link rod bushings. Boring is done to limits of .0005 in.

Trans Canada's well-equipped machine shop in the overhaul base at Winnipeg.

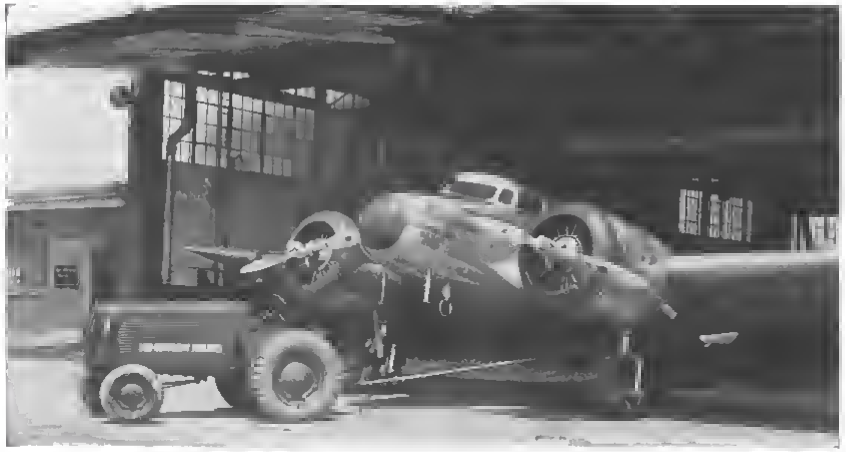


Electrical accessory test bench at Winnipeg. Torque of a starter is being checked.

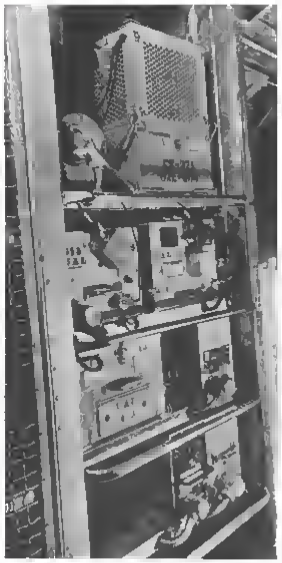


Checking bank and turn indicators and an automatic pilot at T.C.A.'s instrument shop.

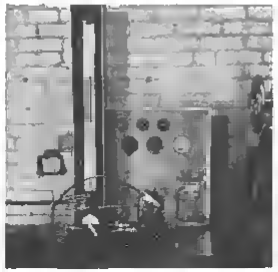
MORE AIRLINE MAINTENANCE



One of Mid-Continent's Lockheeds about to be pulled out on the line at Kansas City

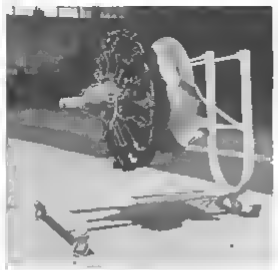


Seventy-five pounds of weight was saved by this radio rack designed by United Air Lines.



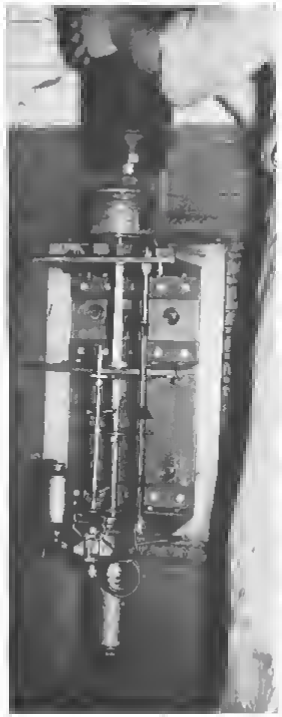
A Penn Central test stand for checking the mixture control of carburetors.

Carburetor test equipment developed by Penn Central at the Pittsburgh base.



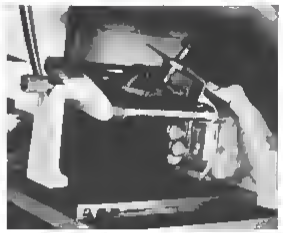
An engine stand used by Mid-Continent at the Kansas City overhaul base.

Test equipment for checking the constant speed units used by Mid-Continent.

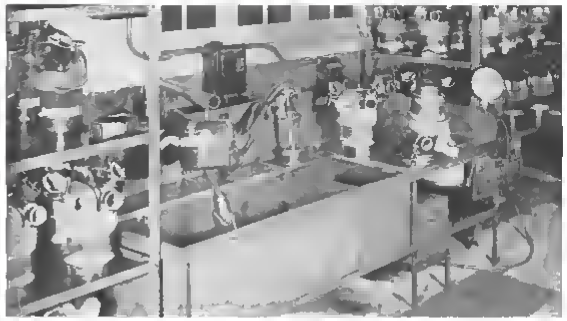


A cylinder honing machine is the maintenance base of Boston Maine Airways at Boston.

Checking the hydraulic system of a transport at Boston-Maine Airways



Testing the rotor of a Sperry gyroscopic instrument at Boston Maine's shop



Steel cylinder barrels at United Air Lines' base are magnetized for the Magnaflux test by holding them inside the ring at the left center of the photograph.

Above: checking calibration of electric tachometer by means of a variable speed drive and a strobotac at Eastern's base at Miami Florida.

Right: engine inspection on an Eastern Air Lines Douglas at LaGuardia Field New York.

Assembly stand for light engines in the shop of Engine Air Service at Roosevelt Field. Front end of crankshaft fits firmly into base. Left: Lary Hoult, right, W. B. Barfoot, owners.

E. W. Wiggins at East Boston has so many light planes in his hangars that he devised this means for conserving space. Strong triangular frames have been welded together and mounted on casters. Front wheels of the planes rest in a groove and propeller is held in a cone rest.

MAINTENANCE
FOR THE
Private Owner

To keep your ship in airworthy condition, have your maintenance done by experts. Here is a step-by-step maintenance procedure which your plane should have

By Frank Say
Southwest Airmotive Co., Love Field,

IF the Creator had meant for men to fly he would have supplied us with wings. The price that we must pay for the mastery of the air is constant vigilance in the operation and the maintenance of the aircraft. The proper maintenance of airplanes in service is most necessary to secure the ultimate of safety, as well as continued efficiency and economy. Careful and regular inspections will eliminate costly repairs by locating and overcoming faults as soon as they may appear. The suggestions in the following paragraphs are intended as a guide for all types of aircraft, and must be supplemented in practice by the requirements for each specific type.

Various agencies may be utilized by the owner to perform the several maintenance operations. These agencies may vary from the pilot making his own daily inspection to a major overhaul by a large repair base. The most important consideration is to have the work done carefully and thoroughly with one object in mind: to keep the airplane in the best possible state of repair and flying condition.

The first element of maintenance is the daily inspection. This may be performed by any licensed airman, and is required to be made once within each 24 hours preceding flight. An entry must be made in the log book by the person making such inspection. This inspection must include the observation of all control wires that are visible, control surface hinges, landing gear, main plane external bracing, control surface covering, exhaust manifold, cowling, propellers as to condition and tightness, condition of the controls and brakes. The engine shall be warmed up, at which time the engine controls and operation of the instruments are to be observed.

The person making this inspection will rapidly become so familiar with the airplane that he will be able to accomplish it in a very few minutes. It is an advantage for the same person to make these inspections continually as he will be more likely to observe any maladjustment that is unusual. Two or three items not mentioned above, but lack of observance of which has caused a number of failures, should always be observed carefully. The fuel tanks, particularly in cold weather, should always be filled before storing the ship. This is to prevent condensation in the tanks. If it is not desirable to fill the tanks, then each morning the tank wells should be drained to prevent the possibility of getting water in the carburetor. For similar reasons, it should be the practice of everyone responsible for caring for an airplane to see that strainers are drained immediately before flight. This is one of the most important daily items, and one which has been neglected far too much. Another item to be carefully watched on ships with hydraulic brakes is to observe the tires to see that no leakage of the brake fluid has occurred.

A clean, dust-free dope room, which has plenty of elbow room, is an asset to an all-around repair station. This is the paint shop of Northwest Air Service at Boeing Field, Seattle. A variety of painted parts for this fuselage are to be seen spread out on the line at the left.

At major overhaul, wing fabric comes off and inspection is made of all parts. New spruce ribs were put into this wing and other rebuilding work done by Aero Trades, at Roosevelt Field.

If such leakage is observed, it is most important to locate and remedy the trouble. The penalty for not doing so may be a ground loop upon landing, and possibly a crackup.

A large number of engines of several types have been severely damaged by the failure to pull the propeller through, particularly after the ship has not been flown for one or more days. There is a possibility in any radial engine that oil may have drained into the lower cylinders, and if it is not cleared out before starting it may break link rods, cases or cylinders, necessitating expensive repairs. To check this, the propeller should always be pulled in the direction of rotation, and if a stoppage is felt the lower cylinder should be investigated. *Never turn the propeller backward if an obstruction is felt.* Doing so may allow any oil that is present to back up into the intake pipe, and possibly enter the cylinder after the engine starts. This precaution cannot be observed too carefully and to guard against the same trouble all starts should be made by turning the engine over with the starter before the ignition is switched on. If there should be any oil in the cylinders the starter clutch will slip, and if such slippage is observed the lower cylinder should be investigated. The best method to remove the oil from the cylinders is to loosen the lowest intake or exhaust pipe and turn the engine over, allowing the oil to drain out. The front plugs should be removed so that inside of the cylinder can be observed. In a recent case, failure to observe these simple precautions cost one owner a brand new engine.

Modern air-cooled engines, particularly those with baffles and speed rings, are very sensitive to inadequate cooling. This also applies to the small engines used in light planes with tunnel cowling. Proper cooling is not accomplished on these engines until forward speed is established. Therefore, excessive running on the ground should be carefully guarded against. I recommend to all pilots, as do the manufacturers, that the engine be started and allowed to warm while taxiing. This warming should be continued at a moderate r.p.m., usually around 1,000 r.p.m., until the heads

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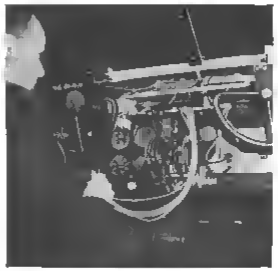
A large hangar like this one is ideal for any approved repair station. Pacific Airmotive, at Burbank, has facilities for all classes of maintenance work.

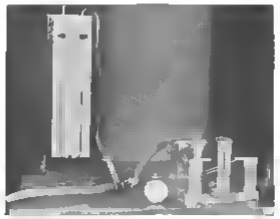
INSTRUMENT MAINTENANCE

In these days of increased instrument flying, a dependable instrument overhaul shop is always busy.



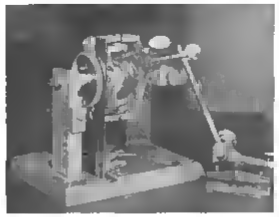
Installing instruments is an important part of overhaul work. Lou Bello is making installations in a new Cessna for C.A.A

Among the several instrument shops which have excellent regulations, one of the best known in the east is Standard Aircraft Instruments, Inc. operated by Lou Bello at Roosevelt Field. This is a corner of his shop showing some of the equipment necessary for checking instruments. On the bench at the extreme right is a Sperry directional gyro. In front of the mechanic on the right is a turn and bank indicator. On the right wall are manometers for testing various instruments. The small box on the right wall is an air filtering and cleaning device.



Calibrating the mechanism of a Sperry gyro. horizon outside the case. This balancing fixture is in Snyder's instrument shop

Another well known instrument shop is that connected with Snyder Aircraft Corporation in Chicago The instrument foreman is checking the calibration of a Sperry gyro-horizon At the extreme right a Sperry directional gyro is on the electrically driven Scarsby, which has a greater roll, pitch and yaw than is met in an airplane during flight. Other instruments are shown in the bell jar on the left ready for tests under atmospheric pressure such as is found in flight On the right wall are a few of the many replacement parts carried by Snyder



In the overhaul of a directional gyro, jigs and tools are necessary so that in engraving the rotor gimbal, tolerances are held to .0005 in. Snyder photograph

Cape Aircraft, at Falmouth, Mass., has built this stand for testing engines up to 500 hp. A monorail and a chain hoist make for fast installation.

A 20 hour check on a Wright Whirlwind at Erickson & Remmert's shop.

PRIVATE ENGINE MAINTENANCE

To keep your engine turning smoothly have it checked by a specialist

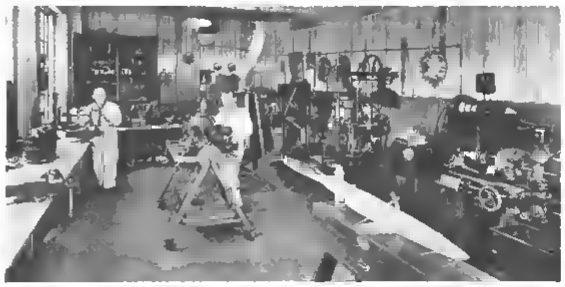
THE engine is the heart of your airplane. Treat it right and it will live to a ripe old age. Abuse it and it will develop coronary thrombosis, angina pectoris or—at the very least—a murmur that will seriously weaken it.

Preventive maintenance is like preventive medicine. A little at a time administered by a "doc" who knows his business, will prevent troubles from developing. Whoever invented that slogan about an ounce of prevention must have been thinking of airplane engines.

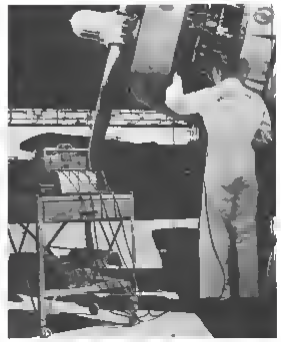
The secret of good health in an engine is regular inspections. There are daily inspections, 10 hour checks, 20 hour checks and so on up to the time for complete overhauls. The airlines have them, our military engines get them, and the engine serving the private owner deserves the same careful treatment. All approved engines today are reliable engines, but maintenance work is done best by men who are specialists.

A 20 hour check on a Continental engine in a Stinson 105 at C. Foley Co.

C. Foley Co., at Roosevelt Field, handles replacement parts for Lycoming engines. With all types of stock on hand, this engine shop gives prompt service.



The engine shop at Northwest Air Service, Boeing Field, Seattle. This shop is an authorized repair station for half a dozen different makes of engines.



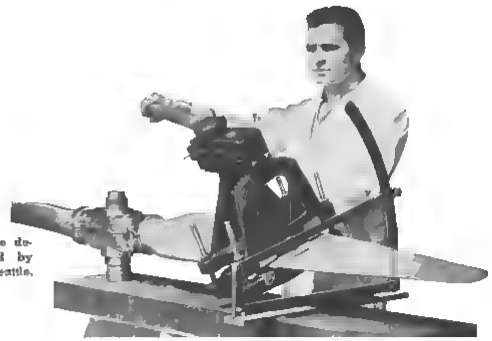
BG Reid testing equipment for checking sparkplugs, used by Pacific Airmotive.

Part of the engine shop at Shultz Repair Depot at Bartlesville, Okla. Shultz services the 34 ships of the Phillips Petroleum fleet, as well as many others.

Cylinder lapping machine devised and built by Engine Air Service, Roosevelt Field, N. Y.

W. S. Burfoot of Engine Air Service with a link and master rod boring fixture developed in the shop.

Part of Foley's engine shop, at Roosevelt Field. Foley specializes in Lycoming engines and built assembly tables and other equipment to handle them. This shop is as clean as a bakery and reflects the careful service given to engines.

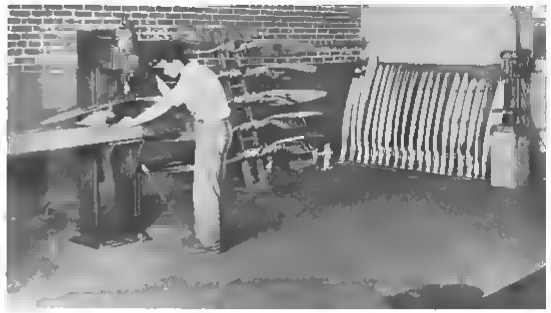


A propeller twisting device designed and manufactured by Northwest Air Service Seattle.

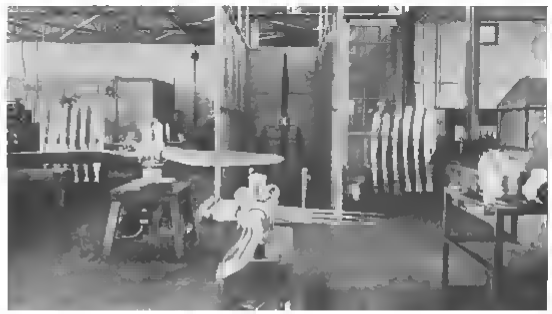
PROPELLER MAINTENANCE

Efficient servicing of propellers is one of the most important points in maintenance. These shops are doing a good job.

A small corner of Pester's Propeller Shop at Roosevelt Field, N. Y. Blades on ships flying in all parts of the country carry the insignia of this overhaul shop



An hydraulic press used for straightening bent blades at Western Propeller Repair, Glendale. Propeller servicing is a maintenance job that must be done by experts.



The propeller shop at Pacific Airmotive Burbank. On the left is a stand for the assembly and testing of Hamilton hydromatic equipment. At the rear is a balancing stand.

PRIVATE AIRPLANE MAINTENANCE

Servicing an airplane is no job for a novice. It requires training, skill and much experience.

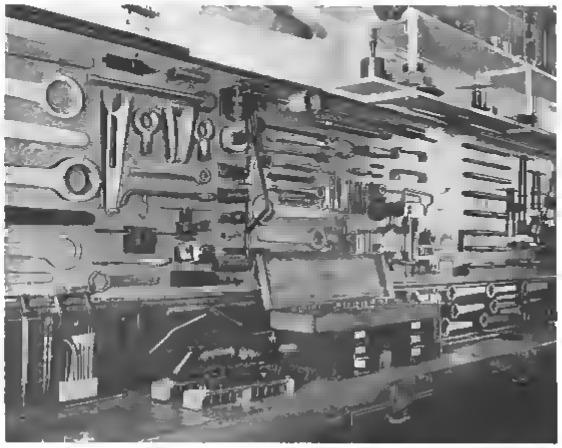
FORTUNATELY for the private airplane owner, a good repair station for planes is much easier to find than a good garage for your car. Every approved repair station must meet federal government standards. Inspections and repairs must be made according to high standards. Mechanics must have passed rigid examinations.

An airplane mechanic is not just a hanger-on who is suddenly elevated from pumping gas to become a repairman. Because he has learned his trade the hard way and been imbued with a strict discipline, he takes pride in his work. He knows that an airplane is worthy of the best service and attention that he can give it.

Winter winds blow cold up in Boston and to keep high priced heat in its hangar, Inter City Airlines uses this canvas curtain.

Dismounting Edo floats on a Fairchild 73 in Erickson & Remmert's shop at Floyd Bennett. Many seaplanes are laid up for the winter, requiring maintenance work.

This battery cart is mounted on coaster-wagon wheels, saving many a backache at Shultz Repair Depot Bartlesville, Okla. Both stand and cart were made by Shultz.

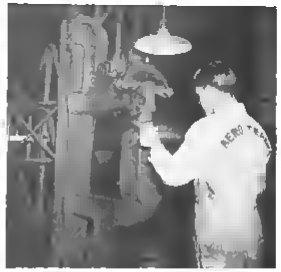


A good supply of tools, kept where you can get them, is the backbone of any maintenance shop. This is part of the supply at Pacific Airmotive, Burbank.

Everyone with an airplane in the Northeast knows Aero Trades at Roosevelt Field. Mac and Dutch turn out dependable work and their hangar is always full of ships. Here is MacIntosh doing the delicate job of balancing a Beechcraft aileron.

Aero Trades mechanics doping the fuselage and fin of a Stinson Reliant after overhaul.

Aero Trades turns out a considerable amount of aircraft sheetmetal parts for the airlines and other buyers. These food containers were made for American Airlines Flagships.



A power bumper being used to form an engine cowling for Ranger Engine. The shop has considerable equipment of this sort for fabricating sheetmetal parts of all shapes.

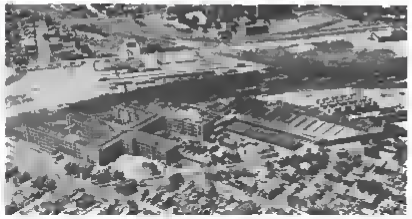
Trimming the edges of engine cowling with sheetmetal snips. Aero Trades specializes in airplane and sheetmetal work, turning over engines and accessories to other shops.

Inspection of stabilizer controls on a Beechcraft that has undergone a major overhaul. Most mechanics here have graduated from an aviation school and have undergone an apprenticeship.

Adding a new plywood cover to a wing panel. Despite the era of all-metal ships in military use mechanics in an overhaul shop must be skilled in various kinds of wood work. During major overhaul, wings are removed, all canvas coverings taken from the ship and all spars, ribs, fittings and weight-bearing parts carefully inspected. Many parts may be rebuilt.

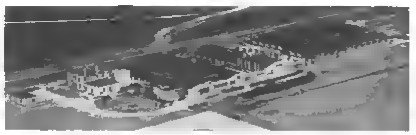
SIXTY PLANES A DAY

By Guy W. Vaughan, *President, Curtiss-Wright Corp.*

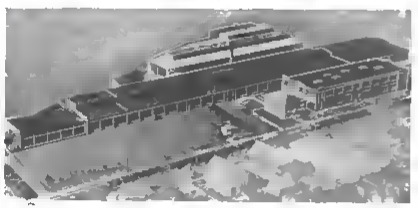


A recent aerial view of the original Plant 1 of Wright Aeronautical Corp., of Paterson, N. J.

Curtiss-Wright's huge Buffalo plant is keyed to present aircraft plants expansion.



The present St. Louis (Mo.) plant which is now being replaced by one eight times as large



Curtiss Propeller Division's Clifton, N. J., factory

WITH the hour of destiny for aviation at hand, an immense expansion program for National Defense has been launched by Curtiss-Wright. Aimed at attaining new high-production objectives at the earliest moment, the project will raise the corporation's output to over 60 Curtiss military planes —ranging from pursuit, dive bomber, observation and training types to huge twin-engined transport cargo planes, daily and 2,000 Wright Cyclone engines monthly, together with large numbers of propellers during each 24-hr period.

Our expansion program contemplates an increase in the corporation's manufacturing area from 3,702,000 sq ft. to 9,327,320 sq ft. of floor space, and a corresponding increase in personnel from a present figure of approximately 27,000 to nearly 80,000 persons. According to present plans, the program will enable the corporation's various manufacturing divisions to attain full production in the late spring or early summer of 1941.

Such a large building program requires considerable preparation and planning. Knowing what to build, how many and when, is a prerequisite to construction. But our first concern has been the care of thousands of Curtiss-Wright employees. The excellent spirit and skill of the American aviation worker deserve the finest working conditions, and this part of our planning occupied by far the most of our time. Therefore, with the human, as well as the material factors in mind, we called upon the best-known architects in industrial design and, together with our own experience, arrived at a working plan. The four manufacturing divisions of the corporation are now well under way with the program evolved.

Wright Aeronautical Corporation

Continuing to set the pace within the corporation, Wright Aeronautical Corp., of Paterson, N. J., began construction of a magnesium foundry at Fair Lawn, N. J.; broke ground for a mammoth plant at Cincinnati, Ohio, and acquired a huge factory in East Paterson, N. J., to be known as Plant No. 4.

The new Cincinnati unit will cost a total of $37,000,000, complete with machine tools and equipment, and is now being rushed to completion. The largest single-story industrial plant ever erected in one unit, the factory will occupy 1,694,320 sq ft. of floor area on a 220-acre site just north of Lockland. The main building will be 1,380 x 1,064 ft., comprising 1,468,320 sq ft.—nearly 35 acres under one roof.

The New Wright Unit

Designed by Wright engineers working in conjunction with Albert Kahn, Inc., Detroit industrial architect, the new unit includes a foundry, covering 160,000 sq ft., and administration and engineering offices comprising 66,000 sq ft. of floor space. The design of the plant is such that it may be expanded 200 percent in the event further increases in production are necessary.

To equip the new plant, the Wright Corp. already has placed orders for machine tools totaling over $20,000,000 and is making plans for employing between 12,000 and 15,000 persons from the Cincinnati area.

When put into full production in the early spring of 1941, the Cincinnati factory is expected to produce 1,000 Wright Cyclone engines monthly. This number will supplement the large scale production of the Wright plants in Paterson, which are now producing engines at the rate of approximately 1,000,000 hp. monthly. These plants are scheduled to produce 1,000 engines monthly beginning early next spring. When peak production is achieved, the Wright organization will therefore produce a total of 2,000 engines per month.

Illustrating something of its previous expansion, the Wright Corp.'s facilities at Paterson have been increased from 900,000 sq ft. of floor space a year ago to 2,100,000 sq ft. by the construction of Plant No. 2 (540,000 sq ft.) at Paterson, the acquisition of Plant No. 3 (450,000 sq ft.) at Fair Lawn, N. J., the addition of space (50,000 sq ft.) in Paterson and various expansions (160,000 sq ft.) of these plants. With the recent acquisition of the East Paterson plant comprising 433,000 sq ft., the completion of the new magnesium foundry representing 110,000 sq ft. at Fair Lawn, and the construction of the Cincinnati unit, the corporation will have a total of 4,337,320 sq ft. of floor area devoted to production. When this expansion is completed the present employment figure will be increased to more than 30,000.

Curtiss Aeroplane Division

The nation's oldest aircraft manufacturer, Curtiss Aeroplane Division, and today its largest producer of combat planes, has inaugurated America's largest individual aircraft expansion program. At Buffalo, N. Y., Columbus, Ohio, and St. Louis, Mo., ground has been broken for three new modern aircraft plants totaling 3,600,000 sq ft. of floor area.

The new Buffalo plant, to cost approximately $12,000,000, will occupy 1,200,000 sq ft. on a 124-acre site acquired by the Defense Plant Corp. of the RFC. Contracts for machine tools and equipment amounting to $1,500,000 and orders for steel totaling $1,166,000 have already been let so that the new unit is expected to be in full production by May 15, 1941.

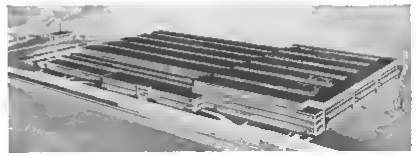
The plant layout was developed by Curtiss-Wright engineers and Albert Kahn, Inc., as the type of industrial design best suited for the mass production of military and naval aircraft. Incidentally, this layout has been closely followed in planning the new units at St. Louis and Columbus. Of modern brick and steel construction, it will comprise manufacturing and engineering sections covering 1,080,000 sq ft. and accessory buildings with an additional 119,250 sq ft. of floor area.

The general layout of the Buffalo plant permits progressive manufacture and assembly, while the offices, engi-

(*Turn to page 150*)

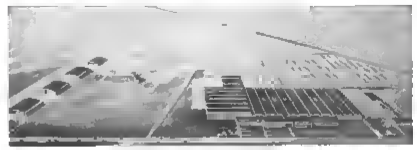
BREAKING GROUND for Curtiss-Wright's new Cincinnati plant. The ensemble surrounded by (Left to right) William W. Finlay, general manager of the Cincinnati plant; Brig. Gen. Oliver P. Echols, Chief of Materiel Division, Wright Field; Emil Schramm, Reconstruction Finance Corp.; and Myron B. Gordon, vice president and general manager of Wright Aeronautical Corp.

The mammoth $37,000,000 plant now being erected at Cincinnati.



A unit in National Defense: the new Caldwell propeller plant.

How the new Curtiss-Wright factories at Columbus and St. Louis will appear



Curtiss Aeroplane Division is rushing its Buffalo factory to completion

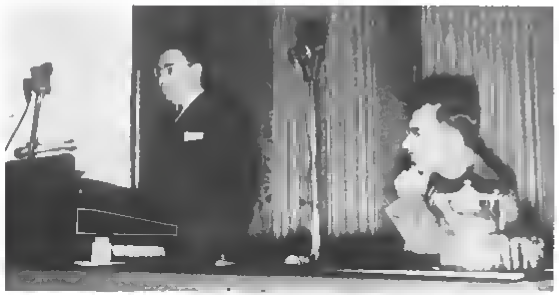
"Only the Productive Can Be Strong—

A report of the 1940 SAE National Aircraft Production Meeting, held in Los Angeles.

Only the Strong Can Be Free"

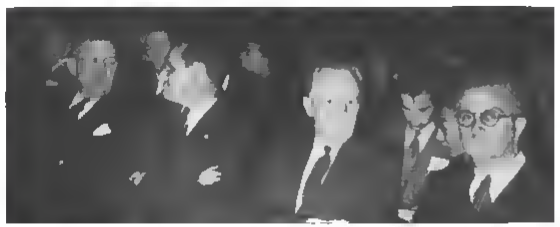
By Charles F. McReynolds

West Coast Editor, Aviation



P. C. Sandretto, United Air Lines (speaking) John Lee, Pratt & Whitney, Chairman, (seated)

A. M. Aircraft Engines Session L. to R.: Dr. O. C. Bridgeman, C. F. R. Committee; Carl E. Swanson, Northwest Airlines; Mac Short, Vega Airplane Co., E. K. Von Mertens Pratt & Whitney.



L. to R.: Robert Insley, Chief Engineer, Menasco Mfg Co., A. E. Raymond, V. P. in Charge of Engineering, Douglas Aircraft Co., John K. Northrop, President, Northrop Aircraft, Inc., T. P. Wright, Curtiss Wright Corp.

EVERY engineer in attendance at the 1940 SAE National aircraft production meeting in Los Angeles knew without being told that the main topic under discussion was not an academic abstraction. It was literally a question of Life or Death! It was the very simple question with which the entire nation continues to wrestle day and night: "Can we build enough airplanes soon enough to defend Democracy successfully from the assault now under way against it?"

While the 50,000 workers in Southern California's aircraft industry worked around the clock to help provide the right answer for that question, the engineers wrinkled their foreheads even further, scratched their thinning hairs fervently, and crammed the sessions at the Biltmore Hotel to set a new all-time high for SAE aircraft production meetings. Total registrations reached the thousand mark and total attendance at all sessions was considerably more than 3,000. On several occasions the hall was jammed to the point of standing room only, and the annual dinner dance on Saturday night was sold out a full week in advance. Which just goes to prove that the poor engineers will go to almost any lengths to escape the daily grind that grows more grim and oppressive with each bomb that falls on London.

In addition to the regular sessions for engineering discussion, the meeting was notable for the success of its engineering display, staged in an adjoining hall for the second successive year. This display was packed with industry people for the full three days of the meeting. Exhibits were highly instructive and up-to-the-minute. Exhibitors and their products were: Air Associates Inc., miscellaneous aircraft accessories and equipment; Air Reduction Sales Co., Airco gas welding equipment and Wilson Hornet arc welders; Aluminum Industries Inc., aluminum castings and forgings and aluminum paint; American Bosch Corp., aircraft engine magnetos and the Parr Ignition Indicator; American-La France-Foamite Corp., fire fighting equipment; Baldwin-Southwark Division, The Baldwin Locomotive Works, SR-4 static and dynamic strain gauges; Bendix Aviation, Ltd., aircraft wheels, struts, hydraulic equipment, radio; Edward G. Budd Mfg. Co., U. S. Army Air Corps pilot seat; The Cleveland Pneumatic Tool Co., air rivet guns and Aerol retractable landing gear; Ducommun Metals & Supply Co., tools, gages, metals; General Metals Co., drop forgings of Timken steel; The Lamson & Sessions Co., aircraft bolts, nuts, and cotter keys; Librascope, Inc., Librascope flight and balance computors; Menasco Mfg. Co., Menasco D-4 and C6S4 aircraft engines; Pacific Metals Co., Ltd., Inconel boilers, cowls, radiators; The Parker Appliance Co., aircraft plumbing; Simmonds Aerocessories, Inc., Simmonds controls; Benton spark plugs; Solar Aircraft Co., aircraft engine manifolds, muffs, cowlings; Swedlow Aeroplastics Corp., special aviation plastic parts; The Timken Roller Bearing Co., Timkin steels, dies, gages, bearings, and a display of Summerill aircraft tubing of Timken steel; United Aircraft Corp., Pratt & Whitney R-2800 2,000 hp. eighteen cylinder long-nose, two-stage supercharger, front-ignition aircraft engine and Hamilton-Standard quick feathering propeller; United Aircraft Products, Inc., aircraft struts and hydraulic equipment; Weatherhead Co., aviation plumbing; Wright Aeronautical Corp., cutaway 1,100 hp. Wright Cyclone aircraft engine.

Richard W. Millar, president of Vultee Aircraft, Inc., served as general chairman of the production meeting. J. H. Kindelberger, president of North American Aviation, Inc., acted as chairman of the aircraft engineering display committee. Arthur Nutt, Wright Aeronautical Corp., and president of the SAE was on hand for the meeting and worked closely with the SAE staff and all Pacific Coast sections of the SAE to make this meeting such an outstanding success.

Strong emphasis placed on mass production methods and on the importance of standardization reminded everyone of the fact that modern wars are won on the production line, not on the firing line. The scope of the papers presented, and of the discussion accompanying their presentation gave to the engineers in attendance a brief glimpse of the great volume of research and investigation constantly going on behind the scenes. One felt a little like a drowning man coming to the surface for one big gulp of fresh air and then sinking back again under water. However, the many evidences of free exchange of industry information led one speaker to observe that the industry has definitely passed the crossroads of attempting to get all information possible and give as little as possible in return. The present spirit of cooperation is encouraging for the future progress of the industry.

Another strong impression borne in on the "lay" engineer as he listened to the details of engine supercharging, cabin supercharging, and ignition harness supercharging, advanced test methods, and flight techniques, was that man's ordinary senses are being infinitely intensified and extended through the scientific application of every known physical phenomenon. Faced with such a wealth of engineering knowledge the observer is at first inclined to surmise that we must be reaching the pinnacle of engineering achievement, approaching the end of an era of inventive progress. But on reflection that this is going on at an accelerating pace year after year one realizes that our engineering knowledge is really just on the threshold of new achievements.

Eight sessions were held during the meeting, including the banquet. For the sake of clarity and brevity we will present the story of the production meeting by topics rather than by sessions, re-arranging those topics in the order of their current timeliness rather than giving them in sequence as held. Five topics were covered including: Standardization, production, materials, engines and electrical equipment. Standardization has been covered in detail elsewhere in this issue and will not be treated here.

The production session with J. H. Schwedes of North American Aviation Inc. as chairman, presented papers by Don R. Berlin and Peter F. Rossmann, Curtiss-Wright Corp., and Paul G. Zimmerman, Douglas Aircraft Co., plus an introduction to the Berlin-Rossman paper by T. P. Wright, Curtiss-Wright Corp.

The Zimmerman paper presented the fruits of many years of practical production experience. Especially stressed was the value of "tote" pans in assembling the small parts to be used on the assembly line. This makes it possible to physically check such parts

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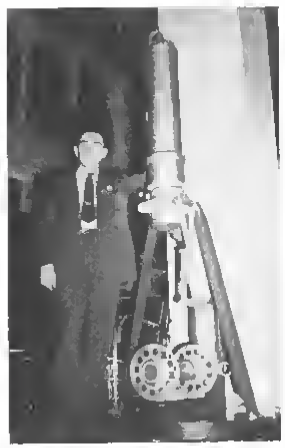
Arthur Nutt, SAE president, delivering his "Off the Record" report of European experiences.

L. to R., Joseph S. Marriott, CAA supervisor, C. F. Lienesch, and Merrill Grix, CAA officials.



W. C. Trautman, Chief Designer Bendix Aviation, Ltd., shown with huge landing gear strut developed for Consolidated B-24 by Bendix Products Division.

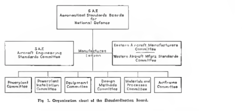


Fig 1. Organization chart of the Standardization Board.

Standardization Takes the Spotlight

at the 1940 S.A.E. National Aircraft Production Meeting

STANDARDIZATION as a production tool, and as an aid to national defense, was thrown into sharp relief by proceedings in Los Angeles, at the 1940 National Aircraft Production Meeting sponsored by the Society of Automotive Engineers Highlight of the meeting was the announcement by president Arthur Nutt of appointment of the S.A.E Aeronautical Standards Board for National Defense, with T P Wright as chairman Final session of the Los Angeles meeting was devoted entirely to the standardization problem with papers to be covered later in this article, presented by Arthur Nutt, Wright Aeronautical Corp, J T Thompson, The Glenn L. Martin Co and Gustaf Carvelli, Wright Aeronautical Corp

Standardization in the aircraft industry was outlined as one of the three essentials to achieving satisfactory production for national defense needs, the other two being trained men, and adequate machine tools It was pointed out to those at the standardization session that aircraft production could be enormously expanded if we were to concentrate all our facilities on building a single type plane, and used in that plane only parts and accessories of standard types which could be built simultaneously by a large number of manufacturing organizations But such a dream of possible mass production is rudely shattered by a consideration of two factors which must be taken into account.

Modern warfare has expanded the number of types of aircraft required for tactical reasons Instead of only two or three types such as were used early in the World War, we now find a need for as many as forty different types of aircraft, with little hope that this number can be reduced below twenty in any mass production scheme Military operations require the employment of several types of training planes, transport planes, ambulance planes, cargo planes, interceptor pursuits convoy fighters, observation, attack bombers, dive bombers, medium bombers and heavy bombers—and so the list grows

Another enemy of standardization is design development With the enemy constantly bringing new and improved types of aircraft into service it is highly dangerous to freeze any design for too long a time And since any airplane is is a composite of nuts and bolts and wire and structural shapes, electrical accessories, hydraulic systems, and mechanical devices all of which are also subject to continual refinement and im[illegible] it is dangerous to standardize any unit at an early stage in its development lest progress in the development of aircraft of higher performance be retarded. An example of this is given by airfoil design From the shop standpoint it would be advantageous in many ways if all wings were to be designed with the same airfoil section, and that section then left unchanged for all time But changes in airfoil design are fundamental to improvement of aircraft performance and will doubtless continue to be so

Finally, standardization is much broader than the problem of designing hardware and fittings It applies to methods used for selecting and training personnel, to engineering and drafting methods and policies followed, to types of tooling equipment and to shop methods, to arrangement of units in the airplane, and to many phases of aircraft design and production which would not ordinarily occur to the engineer in connection with standardization.

These, and many other phases of standardization were presented in the Standardization session, of which Hall Hibbard, Lockheed Aircraft Corp, was chairman. Arthur Nutt outlined the problem in an opening talk, pointing out that much standardization progress could be made at this time, in the name of National Defense, which might otherwise wait many years At the same time he assured the session that the new S A E standards board would move cautiously, that it is thoroughly representative of the entire industry and has the full support of the government, including both Army and Navy air services, and that only those standards would be adopted which could be shown to offer positive advantages from a design and production standpoint These standards, once adopted, would doubtless be universally used for commercial work, as well as military

T. P. Wright was introduced as chairman of the new S.A.E aeronautical standards board Wright pointed out that increased rate of production was only one of five benefits derived from proper standardization, the five being: facilitate engineering, facilitate testing, increase production, improve maintenance, increase reliability and ease of operation

A general discussion of Standardization as Applied to Aircraft Design was presented by John T Thompson, standards engineer, the Glenn L. Martin Company This paper took a broad view of standardization as a tool for speeding mass production to meet our present national defense emergency Since large numbers of new people must be selected and trained for aircraft production work it is essential that a stabilized system of procedure and processing be maintained from the drafting board all the way through to the final assembly line in order that new personnel may be trained with maximum speed

Throughout the factory all bulletins, manuals, and factory publications should be supervised by the Standards Department in order that they may be maintained in a useful and up-to-date condition Through this medium desired procedures and use of parts and tools may be brought to the attention of all employees quickly and uniformly

In the Engineering Department itself a rigidly standardized practice must be adhered to respecting drafting methods and in the use of many engineering forms Copies of the drafting room manual must be provided freely and must be used Standard parts books must be developed and widely distributed in order that available standard and semi standard parts shall be used wherever possible in the preparation of new designs A surprising amount of drafting time may be saved by assembling all drawings of useful but infrequently used similar parts in binders for easy location and re-use when such parts are required in a future design

Where a feature of design has been found impractical for reasons of cost, lack of tooling, or for any other reason, an example of this design, together with an example of a recommended design, should be provided Such examples, collected in binders and available to key personnel in the drafting room will be valuable for future guidance All information concerning kinds, varieties, and capacities of tools and shop equipment available in the plant must also be assembled in manual form and made available to engineering personnel Where the manufacturer is a participant in the Extrusion Die Pool and is

(Turn to page 146)

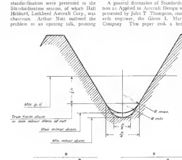
Fig 2. Conversion Table—Fractions to Two-Place Decimals

64ths	32nds	16ths		Decimal Equivalent	Two-Place Decimal Equivalent	64ths	32nds	16ths		Decimal Equivalent	Two-Place Decimal Equivalent
					.01						
1				.0156	.02	33				.5156	.52
	1			.0312	.03		17			.5312	.54
3				.0468	.05	35				.5468	.54
		1		.0625	.06			9		.5625	.56
5				.0781	.08	37				.5781	.58
	3			.0937	.10		19			.5937	.60
7				.1093	.10	39				.6093	.60
			1/8	.125	.12				5/8	.625	.62
9				.1406	.14	41				.6406	.64
	5			.1562	.16		21			.6562	.66
11				.1718	.18	43				.6718	.68
		3		.1875	.18			11		.6875	.68
13				.2031	.20	45				.7031	.70
	7			.2187	.22		23			.7187	.72
15				.2343	.24	47				.7343	.74
			1/4	.25	.25				3/4	.75	.75
17				.2656	.26	49				.7656	.76
	9			.2812	.28		25			.7812	.78
19				.2968	.30	51				.7968	.80
		5		.3125	.32			13		.8125	.80
21				.3281	.32	53				.8281	.82
	11			.3437	.34		27			.8437	.84
23				.3593	.36	55				.8593	.86
			3/8	.375	.38				7/8	.875	.88
25				.3906	.40	57				.8906	.90
	13			.4062	.40		29			.9062	.90
27				.4218	.42	59				.9218	.92
		7		.4375	.44			15		.9375	.94
29				.4531	.46	61				.9531	.96
	15			.4687	.46		31			.9687	.96
31				.4843	.48	63				.9843	.98
			1/2	.5	.50				1	1	1

Even decimals are preferred where fractional figures would normally apply and should be used except in special cases.

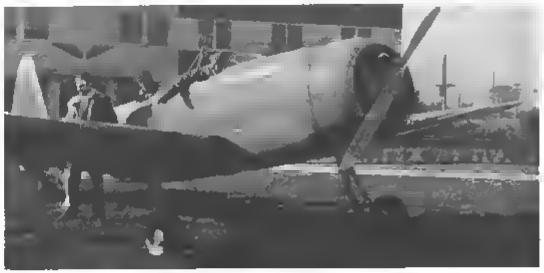
A table to help the draftsman in converting fractions to decimals.

Fig 3 Illustration of the advantage of the 30 degree type spline



Threads per Inch	1/8 of h	R Max.	R Min. Preferred	R Min. Acceptable Ground	R Min. Acceptable Rolled or Milled	R Min. Acceptable Die Cut	Threads per Inch	1/8 of h	R Max.	R Min. Preferred	R Min. Acceptable Ground	R Min. Acceptable Rolled or Milled	R Min. Acceptable Die Cut
80	.0027	.00180	.00135		.001	.001	16	.0135	.00902	.00677	.005	.003	.001
72	.0030	.00200	.00150		"	"	14	.0155	.01031	.00773	"	"	"
64	.0034	.00226	.00169		"	"	13	.0167	.01110	.00833	"	.004	"
56	.0039	.00258	.00193		"	"	12	.0180	.01203	.00902	"	"	"
48	.0045	.00301	.00226		"	"	11	.0197	.01312	.00984	"	.005	"
44	.0049	.00328	.00246		"	"	10	.0217	.01443	.01083	"	"	"
40	.0054	.00361	.00271		"	"	9	.0241	.01604	.01203	"	.006	"
36	.0060	.00401	.00301	.005	.0015	"	8	.0271	.01804	.01353	"	.007	"
32	.0068	.00451	.00338	"	"	"	7	.0309	.02062	.01546	"	.008	"
28	.0077	.00516	.00387	"	.002	"	6	.0361	.02406	.01804	"	.009	"
24	.0090	.00601	.00451	"	"	"	5	.0433	.02887	.02165	"	.010	"
20	.0108	.00722	.00541	"	.0025	"	4½	.0481	.03207	.02406	"	.011	"
18	.0120	.00802	.00601	"	"	"	4	.0541	.03608	.02706	"	.012	"

Fig. 4. A modified thread form for highly stressed parts



The Howard Trainer

FROM the Howard Aircraft Corporation of Chicago comes the announcement of the new two-place trainer (Model DGA-125) built both for training in the Air Corps and for the private market. With a landing speed of less than 50 m p h , and a take-off run of less than 600 ft., this ship should be well suited for use on small airports which will acquire pilot training as a result of the recent ruling forbidding student instruction in any larger airports used as airline terminals

Powered with a 125 hp radial engine, the Howard trainer cruises at 108 m p.h and has a maximum speed of 118 m p h It climbs 800 ft. the first minute, reaching 5,000 ft. in 9¼ min. with the service ceiling 13,500 ft. With an empty weight of 1,350 lb., the new trainer carries a useful load of 607 lb , including fuel for more than 3½ hr of flight, which gives it a cruising range of 365 miles

Many features have been designed into the ship with an eye kept for both ease of maintenance and efficient performance. One of these is the fact that the wing tips, widely known as the vulnerable part of a ship, especially when used for instruction, are replaceable. In the line of safety features, the engine accessory compartment and the entire cockpit are metalclad, and the fuselage aft of the cockpit is of chrome molybdenum tubing, fabric-covered Visibility for the pilot and the student from either side of the tandem seat has been kept in mind and, in the case of an accident, a rigid "turnover" section has been built between the two seats, designed to support 4½ times the full weight of the ship The action of the hydraulic brakes on the landing gear, which is of the fixed type with 9½ ft tread, and equipped with spring hydraulic shock absorbers, has also been designed with safety the predominant feature The tail wheel is steerable from the pedals in the cockpits to prevent ground looping when landing, and also for better control when taxiing. Wings, fins, and stabilizer are of the same plastic construction used for the past five years in Howard airplanes

Both front and rear cockpits are supplied with instrument panels carrying air speed indicator, compass, altimeter, oil pressure gage, tachometer, and oil temperature gage. Specifications for the ship are shown in the accompanying table, which also includes pertinent data on performance.

Specifications

PERFORMANCE

Maximum speed	118 M P H
Cruising speed (75% power)	108 M P H
Landing speed	50 M P H
Cruising range	365 M
Endurance (75% Hp.)	3½ Hr
Climb 1st min after take-off	800 Ft
Climb to 5 000 Ft.	9¼ Min
Take off run	650 Ft.
Service ceiling	13 500 Ft

AREAS

Wing	179.50 Sq Ft
Ailerons	20 20 Sq Ft
Stabilizer	10 70 Sq Ft
Elevator	11 90 Sq Ft
Rudder	6 71 Sq Ft
Fin	9 20 Sq Ft

WEIGHTS

Gross	1957 Lb *
Empty	1350 Lb
Useful	607 Lb

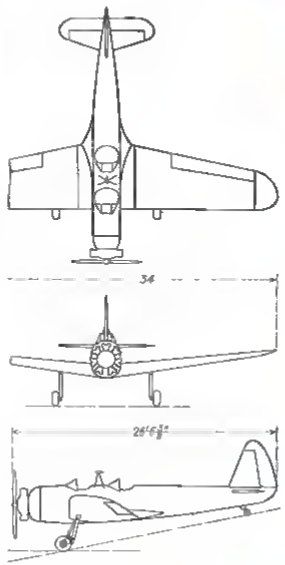
*Designed for 2 008 lb maximum gross weight

GENERAL

Engine—125 H.P radial Warner Scarab—Series 50
(Stressed for 165 H.P.)
Propeller—wood
Ignition—dual
Wings—plywood covered
Shock absorbers—spring dynamic
Landing gear—fixed
Brakes—hydraulic
Tires—8 00 x 5
Weights guaranteed within 3% Performance is corrected to standard conditions and guaranteed within 3%

INSTRUMENTS
Front & Rear Cockpit

Airspeed Indicator
Compass
Altimeter
Oil pressure gauge
Tachometer
Oil temperature gauge



Inflation and Profits

By Selig Altschul

As a result of an indicated increase in the national debt limit, the spectre of inflation has reappeared and has had a psychological effect upon all security values.

The aviation industry does not live in a world of its own and could hardly insulate itself from any of the adverse effects of a broad inflationary wave flowing across our national economy. For this reason, it is important to determine whether or not the latent forces of inflation are to be unleashed.

Authoritative opinion is of the view that no inflationary price rise will be precipitated in the near future. The surplus of many commodities prevailing, excess productive capacities and, more importantly, the broad powers of the government, are all factors that promise to check any unbridled price advances.

Never before has the government interposed such powerful obstacles in the way of price advances as it is doing today. The National Defense Advisory Commission is exerting strong moral pressure to prevent higher prices. The Department of Justice has consistently shown its readiness to proceed legally against any industry under the anti-trust laws, if provoked to do so. Broad financial powers can be exercised by the Federal Reserve Board and the Treasury to stem any inflationary trend. While the government thus far has no legal powers to fix prices, a leading economist, Dr. Marcus Nadler, recently stated that should a sharp increase in prices develop, "the government will seek and obtain the power to control commodity prices."

The whole problem of priorities with which the aviation industry is now becoming so familiar, is but one phase in our increasingly controlled economy. The establishment of a Priorities Board can do much to avoid competitive bidding causing spiralling increases in prices, if clothed with the proper authority.

It is the level of industrial activity and prevailing profit margins that should be the prime concern of the aviation and other industries and not vague fears of future price inflation.

The proposed increase in the debt limit is being sought primarily to obtain further substantial appropriations for national defense. The chief beneficiary of expanded defense activity undoubtedly will be the aircraft manufacturing industry. President Roosevelt has indicated that he will ask Congress for two billion dollars to finance a new aircraft program. Such Congressional approval will bring all defense appropriations and contract allocations close to the twenty billion dollar mark. Prospective further demands indicate that this total may yet go higher.

This new program promises to have all sorts of repercussions. Plans are on hand for government construction of numerous aircraft assembly plants. It is believed that these plants will assemble parts and fuselages produced both by the aviation and automobile industries. Further plans provide for the utilization of the large amount of automotive plants left idle by a number of manufacturers who have withdrawn from automobile production.

Enlarged plant facilities on all fronts are envisioned to handle an augmented program calling for 32,000 additional planes. Of this total, 20,000 would be for the United States and the balance for the British. This British order is important for more reasons than one. The forthcoming program will, for example, stress standardization thus facilitating mass production of planes.

It is becoming increasingly evident that it is this foreign business that will produce the worth-while profits for the aircraft builders. This is strikingly illustrated in the results of operations recently reported by the Douglas Aircraft Co. For the nine months to Aug. 31, 1940, the company reported a net profit of $7,288,335 or $12.15 per share on total sales of $45,430,275. Of this total, however, about $6,125,000 represented sales to the U. S. Government on which profits, after administrative expenses, amounted to $38,614 or less than 1 percent. It appears, therefore, that sales of more than $39,000,000 to foreign governments produced a net profit margin of 18 percent after taxes.

Once again it proves the contention that as long as foreign business continues, the aircraft companies should do well providing of course they can make deliveries in reasonable volume.

The resolution introduced by Senator King to modify the Johnson and Neutrality Acts to enable Great Britain to purchase farm products on credit, may be more significant than the aviation industry would like to believe. Obviously, the English cannot continue to pay indefinitely in cash for the substantial purchases being made in this country and elsewhere. The granting of credit, no matter what the pretext, can have some serious implications. It is conceivable that once a policy of credit was initiated, it is possible that the trend could continue to the extent where the United States Government would for all practical purposes place the British orders. In such a contingency, the foreign market, again for all practical purposes, would cease to exist and the aircraft builders would be dependent on one customer—the United States Government.

The provisions surrounding a government award to one of the major aircraft builders is typical of what the industry may expect under such circumstances. On this contract the company is limited to a fixed fee of 7 percent, subject to final adjustments and before income taxes. No guarantee, however, is given that the company will earn such amount.

In any event, it appears fairly certain that a high level of activity will prevail in the aircraft industry for the immediate years ahead. Profit margins, on the other hand, will be determined by the allocation of foreign and domestic orders.

It is also likely that our rearmament program will bring in its wake heavier taxes, a broadening of the powers of the government over business as well as an increase in wages.

It is but a natural expectancy to anticipate a trend of increasing corporate taxes in the future. The type and form of taxation ultimately to be adopted, however, will have varying effects on the aviation and other industries. There is a good possibility that the recently enacted 24 percent normal corporate tax may be further increased. Informed sources further state that a new tax bill replacing the recent excess profits tax with a levy based on average net return on capital would hit the high-rate-of-earnings companies particularly hard. The aircraft industry would be adversely affected unless exempted through some qualifications.

In this connection, it is noteworthy to refer to a recent report issued by the Federal Trade Commission based on the combined results of operations of nine leading aircraft companies. It was found that for the year 1939, combined net income before deduction of interest on long-term borrowings and income taxes, on total capital of $131,827,219, was $45,405,826, or a rate of return of 34.4 percent on the average of such total employed capital. The rate of return on the average capital employed of $112,375,309 during 1938 was 24.2 percent. It is of further im-

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Designing Loading Charts

For Speeding Aircraft Subcontracting Work

By C. W. S. Parsons *M E, Consultant*

(Rapidly mounting demands on aircraft parts makers call for a closer control of machine loading. Buyers in aircraft factories must know where parts orders can be placed with assurance that delivery dates will be met. In this second of a series of three articles Mr Parsons tells of means being used by some of the parts makers for charting their loads.)

WHAT the aircraft parts makers have to sell are man-hours or machine-hours. What the aircraft companies want to buy are man-hours or machine-hours, put in on the production of airplane parts.

How many hours can a given shop deliver day in and day out, from given equipment? What assurance is there that that shop is accepting only work it can deliver according to schedule? What assurance has the shop that if it only takes work it can finish according to schedule the aircraft factories will keep it continuously busy?

Some of the parts makers are answering these questions with the help of loading charts. In a previous article we have shown a typical loading chart, showing engine lathe capacity only. By reference to Figure 1, it is obvious how the capacity of a variety of machines, and of bench work, can be shown on a single chart. For each major type of operation such as turning, milling, drilling, bench work etc., sub-divided according to practical groupings of equipment, there is a separate charting of load. This load, taken from the original estimator's breakdown of the time on each operation necessary to do the work, and corrected to a net figure comparable with the charted capacity, is plotted according to the calendar days on which the time must be put in so as to meet the delivery schedule.

Since the vertical scale of the chart is a measure of man-hours or machine-hours per day, the load appears as an area whose top boundary is a broken line defining the number of man-hours or machine-hours the shop has so far agreed to put in on each working day.

The area above the load and below the capacity line represents unfilled capacity. Therefore for any given day the shop and factory both know that the space between the load line and the capacity line, read to scale, shows how many man-hours or machine-hours can still be contracted for for that day.

Every week or ten days, in the case of machine shops working on a jobbing basis, the vendor graphically summarizes his net load, blueprints his chart and furnishes the aircraft factory buyers with copies.

The net result: "It gives you a picture of your own shop which you would not otherwise have, showing your obligations for work taken into the plant," according to John Madill of Madill, Inc. As Bill Partridge, his estimator, puts it, "I think the big value of the loading chart is that it makes the other fellow—at the factory— know what we know."

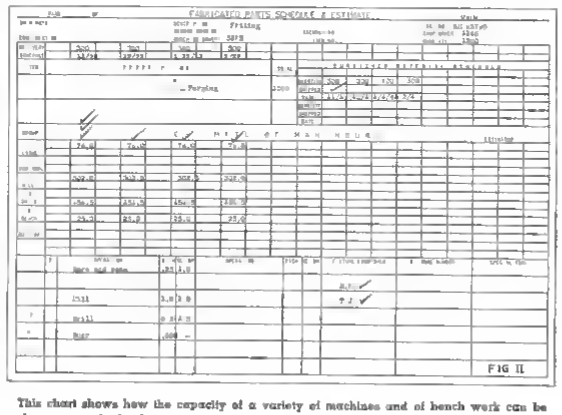
E. R. Chilcott, of Technical Products Co., Inc., expresses it, "I don't see how you can get along without a loading chart of some kind if you expect to carry your share of the big load to come and keep holding to scheduled deliveries."

The reaction of S. W. Gilfillan of Gilfillan Bros. Inc., is, "Our men are really using the charts and can't do without them. They are serving as a means of self-education."

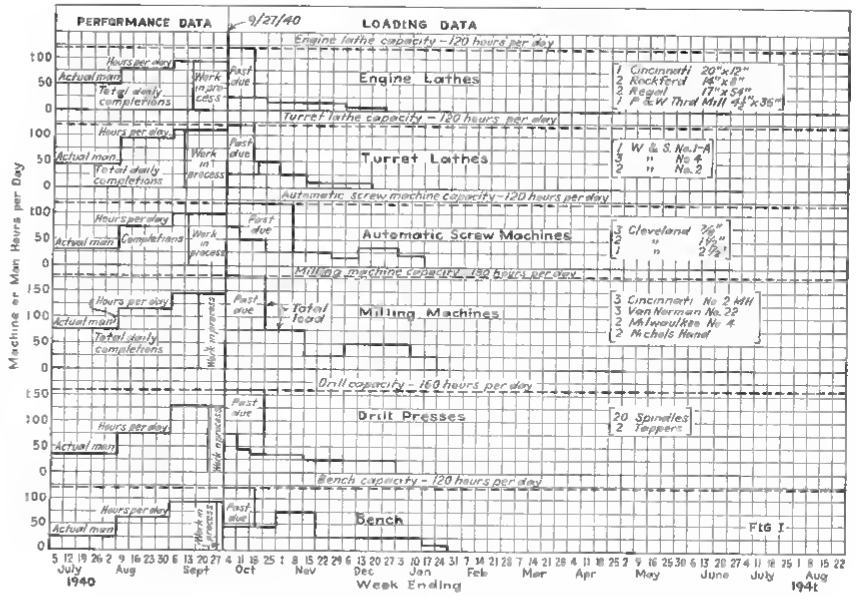
With that kind of foundation laid for cooperation it would be hard to believe that the aircraft factory buyers would fail to keep orders flowing with reasonable regularity to the outside production shops.

Setting up the loading chart can best be done by an engineer familiar with the needs of the aircraft industry. Time is undoubtedly of the essence of every aircraft function to-day. The buyers do not want to fool around with interpreting half a dozen kinds of charts when one design will tell the story. Key men in machine shops can't spare time from the work they are already doing, and usually have not had much, if any, experience in setting up loading charts. There is every reason to want the charting function, including whatever handling there is of shop data such as time records, purchase orders, shop packing lists, aircraft company shippers, etc., to be designed so that there will be no interference with regular office routine.

Under proper supervision someone in the organization may be trained in a very few weeks to handle the charting in a few hours a day in the average



This chart shows how the capacity of a variety of machines and of bench work can be shown on a single chart.



For organizing the estimated times of operations by due dates, a work sheet like this is drawn up.

shop. The job of picking up the initial load of all orders on hand serves as an excellent opportunity to lead the embryo chartsman step by step through the learning process. Thoroughness of execution and neatness in drawing and lettering the charts themselves are necessary and should be insisted upon. But there is no reason why the work cannot be done by someone still coming up in the organization who may need special instruction at the start.

Thus practical considerations point to the desirability of depending upon an engineer to train someone and to see that the tie-in with existing shop-office procedure is handled smoothly.

In getting ready to make up loading charts one of the first things to do is to make up a list of machine tools by operation groups, and to find out the number of hours per day this equipment can be run. Outside of determining immediately the layout of the loading chart to provide space according to the various operation capacities, this information in effect builds the picture of the shop as it is or will be.

If the shop is running on a job operation basis, past experience has led to building up the equipment to satisfy approximately the demand for performing certain operations characteristic of aircraft parts. The range of these operations has in effect determined the range of the equipment which for the most part is more or less universal in purpose.

Therefore, for a job shop it is usually satisfactory to divide the operations to be charted into major groups, such as turning, milling, drilling, and bench. Then according to the particular shop, the groups are further sub-divided into engine lathes, turret lathes, automatic screw machines, etc.

Certain machines, because of similarity of purpose or operation, are thrown in with the main groupings, particularly when they are not regularly used. For instance, a thread mill with the engine lathes. A shaper, used for facing casting bases, with the milling machines. A hone with the drill presses. A cut-off saw with the bench. Unless they are used considerably they are not rated better then a fraction of a machine in capacity. But if any such equipment is used steadily it should be rated at full capacity, and if there are enough units, separated into a special group.

Obviously in the case of shops doing business as manufacturers, and not as job shops, the procedure is somewhat different. In the case of the job shop each group of machines might be looked upon as a reservoir of machine hours into which to pour a conglomeration of bar stock, tubing, castings, forgings, etc. If any group shows on the chart over a period of time to be overloaded or underloaded, some attempt is made to adjust the type or range of jobs coming in, to balance up machine operations before purchase of new machines is considered.

But with the manufacturer there is a different approach. A more definite program is mapped out in advance, tying together the need of the aircraft factory and the shop's ability or equipment to meet it. Contracts for specific lines of parts, to be made over a period of many months, are negotiated. The man or machine-hours involved are analyzed in detail and the projected load charted on a calendar basis to determine what equipment must be made available, and purchased if necessary. From this it follows that the machine-tools may include more special-purpose

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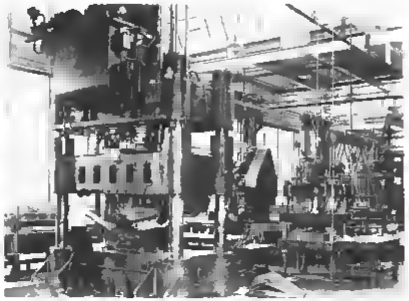
BOMBERS IN QUANTITY

In the previous issue was the description of the Glenn L. Martin Co.'s production system. Part II presents pictorially many of the important steps.

By Jay P. AuWerter *Assistant Editor*

Research is an important factor In the research lab is the necessary equipment to test new developments, both in design and materials

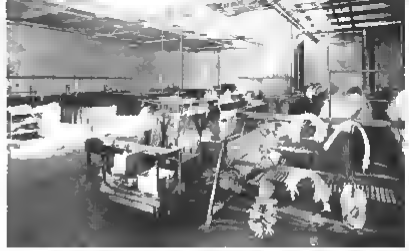
Dies for presses are first formed in plaster; then zinc and lead.



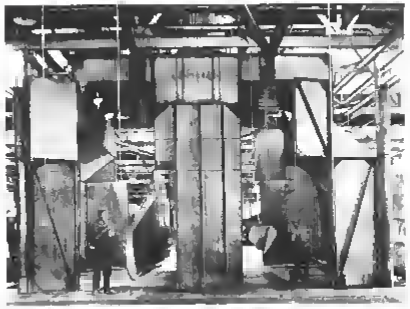
800 ton presses are used to form various aluminum alloy sections.

Boats built in the Navy Bay are built in steel jigs at the left Sub-assemblies and small parts are in the right center, and the finished ship at the far left is taken out through the large doors onto a cement ramp

The Glenn L. Martin Company's photographic reproduction process mounts the drawings on the right and the camera at the left.



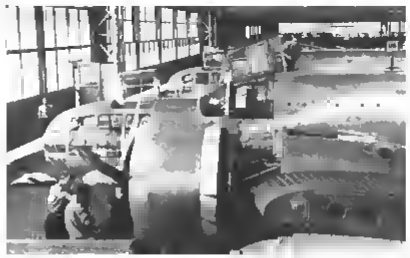
In the machining room the machining baths are at the right with overhead cranes to lift the materials in metal buckets.



Large wing panels can be painted as a unit in the spray booths.

Line of Warner & Swasey screw machines in the machine shop

Nose sections are built in halves for accessibility by workmen



Looking down the final step in the French Bomber production line.

Loading export crates for the 187 bomber on the railroad siding.

PROVED By 7000 Hours' Service

Stainless manifolds now standard equipment on many famous ships

NOW, added to the inherent advantages of U·S·S Stainless Steel for exhaust manifold systems, is another fact which cannot be overlooked. Stainless manifolds have successfully passed the most rigorous tests of all—actual service tests of 5000 to 7000 hours' flying time.

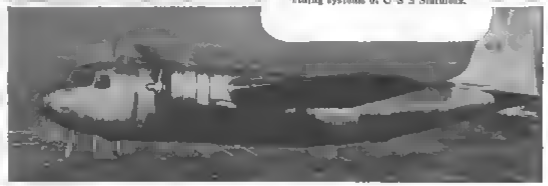
A brief summary of the properties of U·S·S Stainless Steel shows why it is the logical material for aircraft manifold systems — why stainless is today the most widely accepted construction employed both in civil transport and in U. S. Army and Navy ships.

1. It has a high ultimate strength, even at prolonged temperatures from 1000 to 1600°F.
2. It stubbornly resists corrosion—remains unaffected by either atmospheric exposure or the corrosive products of modern "doped" fuels.
3. It minimizes oxidation scale, throughout the entire temperature range.
4. It effectively resists abrasion at points of metal-to-metal contact.
5. It has excellent qualities for deep-drawing, bending, welding—can be fabricated easily, speedily, and efficiently.

These advantages make the stainless manifold the safest, most efficient, most all-round economical construction ever developed for aircraft service. Write today for complete information.

STAINLESS MANIFOLDS are easy to fabricate. Here is how one prominent aircraft producer does it. Flat sheets of U·S·S Stainless Steel are here deep drawn to form half-sections. The half sections are later welded together to form the complete manifold. Proper design assures adequate metal thickness at all points. The stabilized material which is not subject to intergranular corrosion is used in this construction.

Civil transports and fighting ships alike are now equipped with manifolding systems of U·S·S Stainless.



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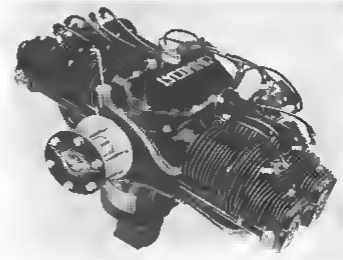

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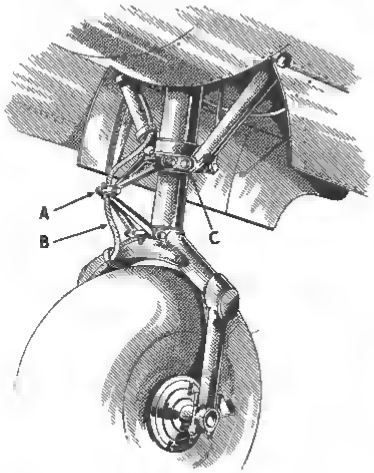
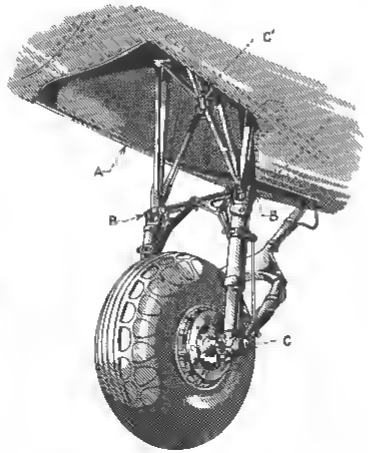
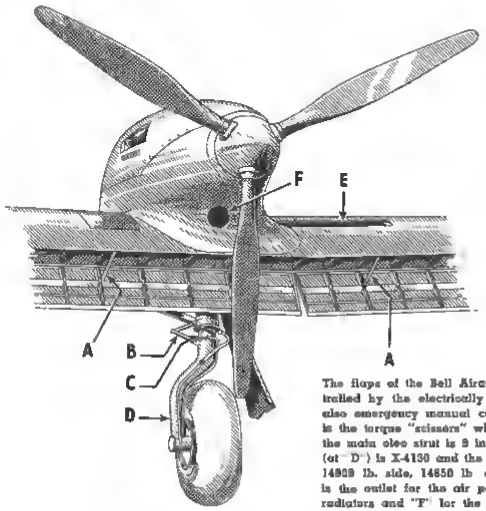


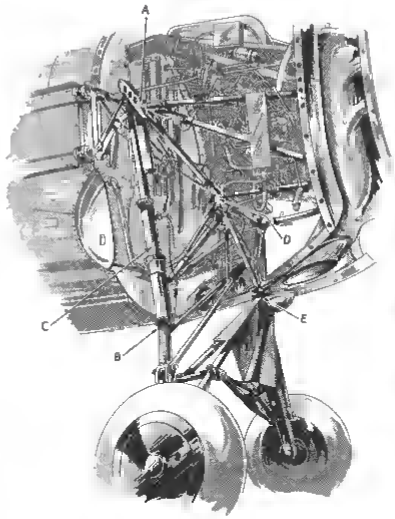
The landing gear of the Beechcraft Model 18 is designed so that in retracting the whole assembly swings back into the nacelle on hinges. "A" is the "scissors" to restrain the torque of the wheel and is attached at the top and bottom by through-bolts. "B" is the hydraulic line to the brake. At point "C" through-bolts attach the oleo strut to welded steel tube side brace struts.



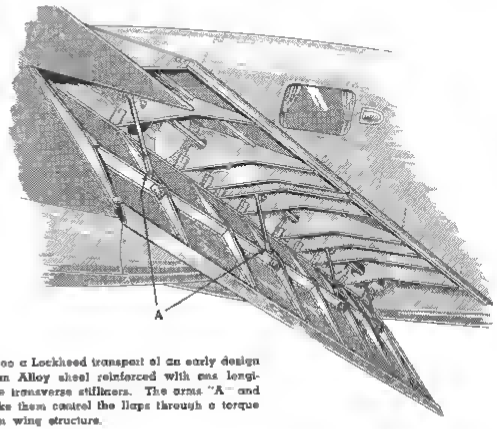
The landing gear of the Douglas DC-3 is built so that the tire is raised into the well "A" in the bottom of the nacelle. To do this the assembly is hinged at point "B", which pulls forward and up so that the axel "C" is raised to "C'"



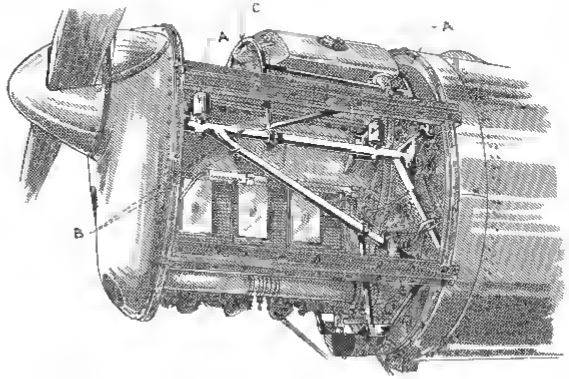
The flaps of the Bell Airacuda two-engined bomber are controlled by the electrically operated controls "A" which are also emergency manual controls. On the landing gear "B" is the torque "scissors" while at "C" the length of stroke of the main oleo strut is 8 inches. The steel used in the struts (at "D") is X-4130 and the strut is designed to take a load of 14928 lb. side, 14850 lb drag and 51540 lb vertical. "E" is the outlet for the air passing through the engine coolant radiators and "F" for the oil cooling radiators.



The landing gear of the Grumman fighter is attached to the fuselage at points "A" and "E". When being retracted point "B" swings inward and around the hinge point directly below so that the wheel moves upward into the well in the fire-wall and flush with the outside of the ship. "C" is the oleo strut and "D" is a section of the engine mount which is built around the retracting mechanism



The hinge flaps on a Lockheed transport of an early design are of Aluminum Alloy sheet reinforced with one longitudinal and nine transverse stiffners. The arms "A" and the other two like them control the flaps through a torque tube to the main wing structure.



The 150 horsepower Menasco engine is installed in the Ryan S-T-A Special at four points two of which are indicated by "A." These are rubber vibration damping mountings the center section of which are attached to the engine mount "B". "C" is the structure supporting the oil tank.

SHOCK ABSORBING SYSTEMS

By Walter A. Semlon *Hughes Aircraft Company*

THE design of the airplane landing gear shock absorbing system presents several closely related problems every one of which should require a separate study. So far as large military and commercial aircraft is concerned the present trend is definitely in favor of oleo-pneumatic or pneudraulic shock absorbers because of their smooth action, adjustability, durability, and relatively light weight. Rubber as well as steel springs have intrinsic characteristics which are difficult to control. The air spring, in this respect, has marked superiority on landing as well as on taxiing since its dynamic rate of oscillation can be controlled by changing the pressure in the air chamber of the strut

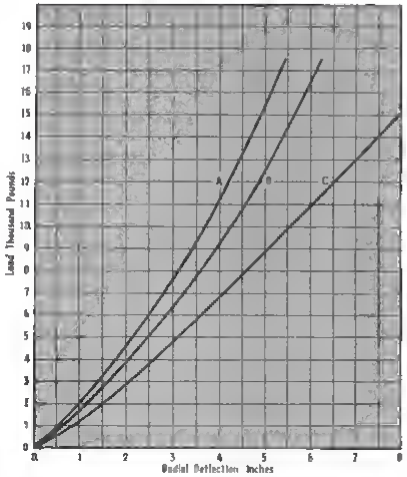


Fig. 1. Comparative load deflection curves for high and low pressure tires.

A. Tire—streamline—18 ply—size 45
O dia 45.80" sect width 14.40"
Rated max. static load 9200 lb
Infl. pres. at max. stat. load 40 lb.
Max. avail. radial deflect 7.80 in
Approx collapse load 31500 lb
Max. energy absorbing capacity 9000 ft. lb

B. Tire—streamline—8 ply—size 45
O. dia 45.80 sect width 14.40
Rated max stat load 8100 lb
Infl pressure at static load 42 lb. p.s.i.
Max available radial deflect 7.75 in.
Approx. collapsing load 25800 lb.
Max. energy absorb capacity 8835 ft.-lb

C. Tire—low pressure 6 ply
O dia 42.40" sect width 14.90"
Rated max static load 7000 lb.
Infl pres at max. stat load 23 p.s.i.
Max available radial deflect 10.5 in
Approx. collapsing load 20500 lb.
Max. energy absorb. capacity 6480 ft.-lb

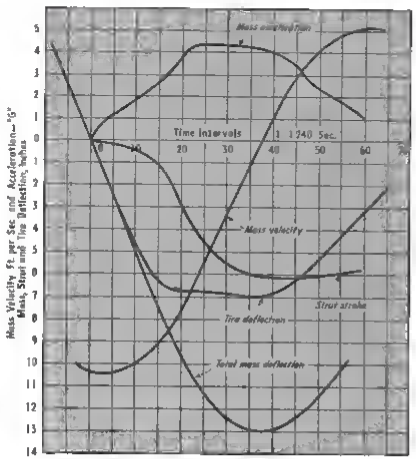


Fig. 2 Typical performance curves for pneudraulic strut and pneumatic tire combination obtained from drop test records. (left)

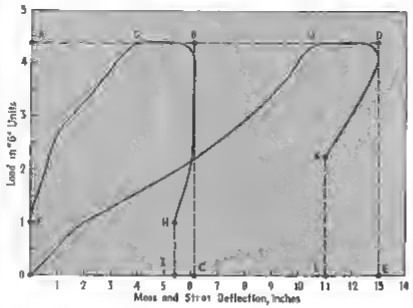


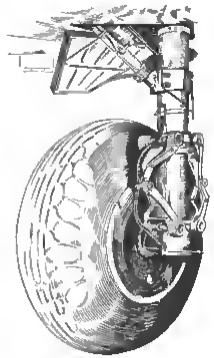
Fig 3 Pneudraulic strut and main landing gear efficiency diagrams.

The Landing Gear and the Shock Absorber

The shock absorbing system of the airplane consists essentially of a pneumatic tire and a shock absorbing strut fixed in their relative positions by the geometry of the landing gear structure The design requirements of the system depend upon design criteria of the landing gear to such an extent that it is no longer possible to supply standard shock absorbing units for two aircraft of the same gross weight but of different landing gear design

The type of airplane, the design load factors, the geometry of the landing gear and retracting mechanism, and the stresses in different members under various loading conditions will affect the design requirements, although the gross weight of the airplane, the position of the wheel and of the shock absorber with respect to the center of mass will have the decisive part in the design criteria

There are different types of the landing gear structures in use, although they can be generally subdivided into the following three classes framework, semi-cantilever and cantilever Each one imposes its own requirements upon the design of the shock absorbing system. In some frame installations the pneudraulic strut will serve as a pin ended short column, other frame installations and semi cantilever structures will impose on shock struts both compression and bending, while in pure cantilever and some semi-cantilever installations the shock strut is required to take compression, bending and torsion Heavier walls are required to take bending besides column stress, while special provisions such as sliding spline torque tube or "scissors" would be necessary to take torsion



DC-4 Main landing gear. Strut in fully extended position.

The Shock Absorbing Qualities of a Tire

The principal functions of the airplane tire are to support the weight of the airplane and to cushion this weight over the irregularities of the landing field The airplane tire represents an air inflated cushion enclosed within a rubberized fabric casing and mounted on a wheel The inherent stiffness of the airplane tire walls when compared to that of an automobile tire of the same size is very low, therefore it is possible to determine fairly accurately the shock absorbing qualities of a given tire from the data on air capacity, which depends upon the tire size and the inflation pressure The independent variables of the tire size are outside diameter, the width or the diameter of cross-section, and the form ratio, i.e. the ratio of the outside diameter to the diameter of cross section The radial deflection of the tire subjected to increasing loads and the elliptically shaped area of contact formed during the deflection against a hard flat surface are of prime importance in determining the tire loading capacity

Since the principal function of the tire is not the dissipation of the energy, but the cushioning of the airplane weight, the tire should possess moderate deflection due to impact, ample clearance between the wheel rim and the ground when rolling over fairly large obstacles and a certain consonance with the elastic properties of the pneudraulic shock absorber. The last quality is essential due to the fact that on landing and during rough taxiing the tire deflection supersedes that of the properly inflated oleo strut and on subsequent rebound the tire should be able to give part of its stored energy to the strut before the latter reaches its maximum stroke, so that no excessive bouncing would occur (During the working stroke, when the airplane mass is deflecting downward, damping in the tire tends to decrease this downward motion On recoil stroke, when the tire tends to return to its original shape the mass of the airplane is moving upward and the damping in the tire again tends to minimize this upward motion)

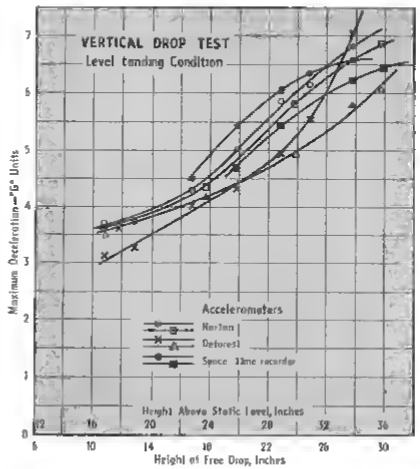


Fig. 4 Vertical drop test acceleration records obtained simultaneously with several recording accelerometers.

The load absorption curves obtained from the static tests indicate low energy dissipating quality of the tire which generally varies from 9% for high pressure tires to 12% for low pressure tires The dynamic tests indicate a somewhat higher although not appreciable energy dissipating capacities For the purposes of the shock absorber design it is conservative to assume that a given tire will be able to dissipate 10% of its stored energy

The development of large aircraft with high wing loadings and high stalling speeds imposes new demands upon the design of wheels and tires From the airplane designer's standpoint the properly selected tire should be of medium pressure type (40–50 p.s.i.) with the smallest possible diameter A larger size tire than necessary does not help materially in dissipating energy on landing, this can be done much more efficiently by the use of the proper shock absorbing strut

Pneudraulic Strut

The functioning of the landing gear shock absorbing strut is similar in principle to the hydro-pneumatic recoil system used on heavy guns and on catapults Its primary purpose being the absorption and the dissipation of kinetic energy on landing and on taxiing

There are a great variety of patented designs of pneudraulic struts now in use, although essentially the device consists of two hollow telescopic metal cylinders closely fitted and hermetically sealed by means of suitable packing to prevent loss of air or liquid through leakage. The lower chamber is filled with a special hydraulic fluid while the upper one contains air at high pressure (100 to 1,000 lbs) The piston type end of the inner cylinder is equipped

(*Turn to page 136*)

DEFENSE

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In the present emergency, we believe our commercial customers will make allowances for the priority of Government requirements and the heavy load which we have assumed as our share in the Defense Program.

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AMERICAN CABLE *"Korōdless"* AIRCRAFT CONTROLS

The B.M.W. 116 Aircraft Engine

Designed to fill the need for a medium-powered vee-type engine for advanced German training purposes, the B.M.W. 116 represents a field given serious attention by Germany.

By Paul H. Wilkinson *Consultant, Diesel Aviation*

THE B M W 116 aircraft engine primarily was designed to fill the need for a medium-powered vee-type engine for advanced training planes in which pilots could gain experience before passing to first-line fighting planes equipped with high powered vee type engines Although little has been heard about this B M W engine it was developed about the same time as the Junkers Jumo 210 which is of the same basic type with inverted water-cooled cylinders The German Air Ministry chose the Junkers Jumo 210 for training purposes for the Luftwaffe and so the B M W 116 never was placed in production.

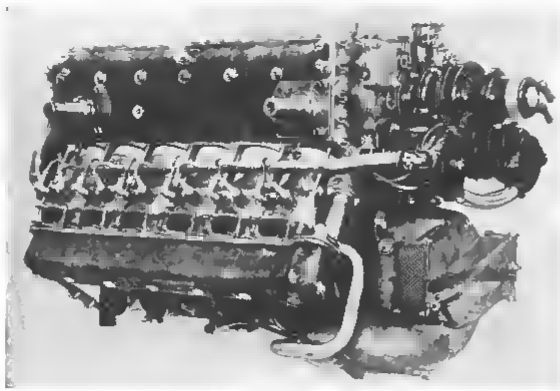
The field of the medium-powered vee-type engine is an important one and it has been given serious attention in Germany and England Engines with power outputs of approximately 600 hp are much cheaper to build than engines of 1,200 hp and their fuel and lubricating oil consumption is less They give an excellent performance to advanced training planes and eliminate tying up first-line planes for training purposes Furthermore, they reduce danger of crashes as the planes in which they are installed can have lighter wing loadings and lighter power loadings.

The B M W 116 engine with its displacement of 1 267 cu in and output of 600 hp at 11,800 ft is in the same category as the Junkers Jumo 210 (1 202 cu in displacement and 545 hp at 13,750 ft) and the Rolls-Royce Kestrel (1,296 cu in. and 745 hp at 14,500 ft) These engines pinch-hit in training planes for the more powerful Junkers Jumo 211 and Mercedes-Benz DB 601 in Germany, and the Rolls-Royce Merlin in England Here in the United States we do not have an engine in this category with which our pilots can obtain experience before graduating to the Allison

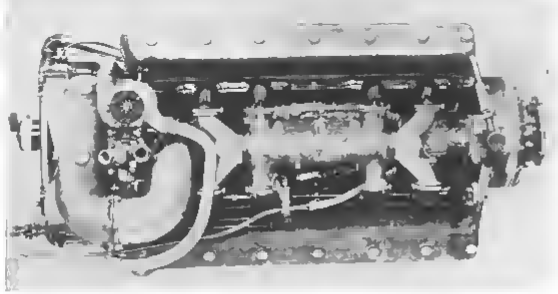
In design and construction the B M W 116 is a conventional vee-type engine with twelve water-cooled cylinders arranged in two inverted banks with an angle of 60 degrees between them Each cylinder block is attached to the crankcase with fourteen long hold-down studs passing through portions of the block adjacent to the combustion chambers in the cylinders This arrangement transmits stresses in the cylinder heads direct to the crankcase without the need for flanges on the ends of the cylinders and short studs and nuts

Two inlet valves and two exhaust valves are provided in each cylinder and they are actuated by overhead camshafts driven by vertical shafts at the rear of the engine The intake manifolds are attached to the inside of the cylinder blocks and the exhaust openings are on

(*Turn to page 152*)



Three-quarter rear view of B.M.W 116 aircraft engine showing double air intakes to supercharger and mounting of other items of equipment.



Underneath view of engine showing location of carburetor and intake manifolds

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What's New in Accessories, Materials, Supplies, and Equipment

Adaptability of hydraulic to aircraft accessory actuation is well illustrated by introduction of the Pesco piston pump, Model 442 by the Pump Engineering Service Corp, of Cleveland, Ohio This new Pesco unit may be used as either a pump or a hydraulic motor As a motor it will actuate mechanisms just as an electric motor would Rotation as a motor can be in either direction through controlling flow of the hydraulic fluid High pressure and efficiency can be maintained at any speed from as low as 50 r p m up to 4,000 r p m The overall efficiency as a motor is said to be in excess of 80 per cent, and the unit gives a 5 hp output, or approximately 1 hp per 8 lb The Model 442 Pesco pump is a very compact seven cylinder unit employing the well established "Waterbury" principle It is capable of developing 1,500 lb per sq in continuous duty pressure, or more than 2,000 lb per sq in. pressure intermittently Continuous duty operating speed is up to 3,500 r p m and intermittent speed up to 4,000 r p m—AVIATION, *December, 1940*

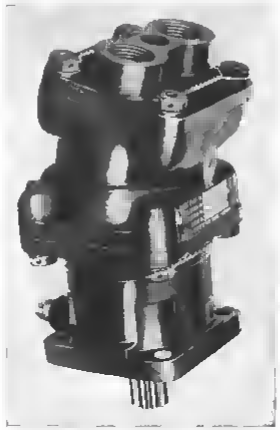
Developed for testing aircraft generators, vacuum pumps, hydraulic pumps, alternators, etc., the Aero test stand offered by U S. Electrical Motors, Inc, Los Angeles, is of 15 hp capacity and has a speed range of 1,900 to 13,000 r.p.m Use of the test stand will determine whether generators will carry the rated load through normal operating speeds, and whether the clutch will remain engaged throughout the normal engine operating speed and disengage at a predetermined speed Positive speed changing may be affected to 1 r.p.m. through the vari-couple drive from a constant electric motor A positively driven magneto generator and calibrate speed indicator accurately show the output r p m of the test stand—AVIATION, *December, 1940*

Eight distinct new advantages are claimed for the Veeco drafting machine offered by the V. & E. Engineering Co, Pasadena, Calif. Of special interest is the combination automatic and manual indexing feature. Other advantages listed include a positive band-tightening device, smooth elbow brake, flexibility, full circle baseline setting, central skid button, positive scale holder, and large protractor for easy reading—AVIATION, *December, 1940*

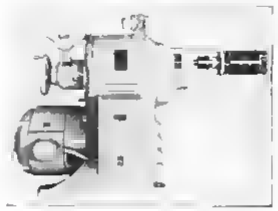
Each new development in the field of blueprinting, whiteprinting, or drawing reproduction finds a ready response in the aviation engineering departments which are probably the world's leading producers of square yards of engineering drawings by a wide margin. So there will doubtless be much interest shown in the new Ozalid Model "F" medium price fast printing whiteprint machine introduced by the Ozalid Corp, Johnson City, N Y In the Ozalid Model "F" the printer and dry-developer are combined in one compact unit easily installed in any drafting room Although it comprises all the facilities needed to reproduce dry-developed Ozalid whiteprints in less than 2 min., the machine requires less than 14 sq ft. of floor space and is claimed to use less than one-half the electrical energy of earlier printers of equal capacity—AVIATION, *December, 1940*

A considerable number of the newly announced Lindberg Cyclone Production box-type tempering furnaces are already in use in the aircraft industry due to the value of this furnace for accurate heat treatment of aluminum sheets and castings, tempering of steels, stress relieving of welded structures, etc Standard temperature ranges are 200 to 850 deg. F and 200 to 1,250 deg F Heating is rapid and uniform due to the high velocity circulation of hot air within the furnace by means of a pressure blower type fan—AVIATION, *December, 1940*

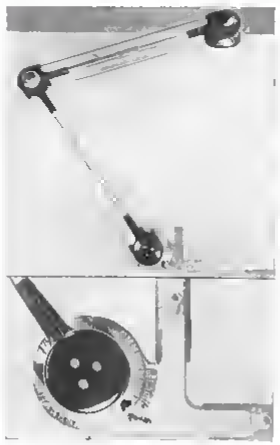
A light for locations where no electric current is available, or where it is hazardous to introduce electric extension cords, the storage battery emergency lamp introduced by Stewart R. Browne Mfg Co., Inc., New York, N Y., should prove valuable for many aviation activities, including emergency uses around airports, emergency repair work away from airports, and various uses in connection with aircraft factory work during these days of 24 hr shift work—AVIATION, *December, 1940*



Pesco piston pump—Model 442

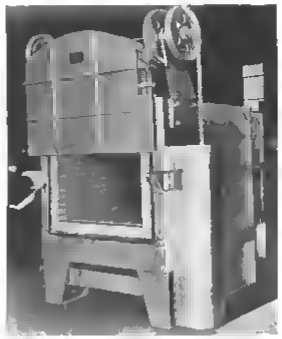


U.S Aero test stand

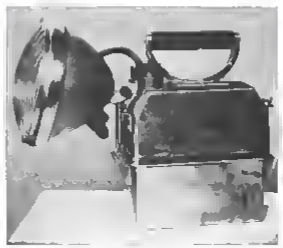


Veeco drafting machine

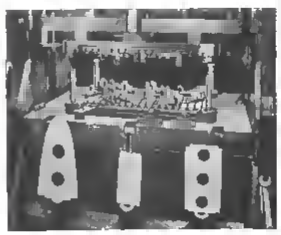
Ozalid Model "F" whiteprint machine



Lindberg electric tempering furnace



Storage battery emergency lamp



Whistler universal die sets

Made in various sizes, universal adjustable die sets which are a great aid in reducing time to get into production on sheet metal punching and notching operations have been developed by S B Whistler & Sons, Inc, of Buffalo, N Y Once in the possession of the user these adjustable die sets may be rearranged as often as the manufacturer desires for various jobs of punching, perforating, or notching One firm recently made a set-up with this equipment in less than half the time and about one-twentieth of the cost previously required by other methods—AVIATION, *December, 1940*

A new hydraulic selector valve comes from Fleetwings, Inc, Bristol, Pa. Designed to operate landing gear retracting systems and other two-directional airplane parts requiring intermittent operation, Fleetwings' B 1-E selector valve will operate without seizure from below 40 deg F, to above 200 deg F, Outstanding feature is a centering spring and electric releasing mechanism, so arranged that, when the valve has functioned, an electric switch, or switches in series, are closed which release the centering spring to return the valve to its neutral position where unrestricted flow of the circulating fluid is again established While designed to return to the inactive position automatically, the valve can be returned manually without interfering with the automatic device, which is a separate unit The valve is fully balanced, requiring a minimum force (3 to 4 lb) to operate over and above the force used in overcoming the centering spring Care has been used to enable easy disassembly and assembly by ordinary mechanics Weight, complete with automatic return mechanism, 2 1 lb.—AVIATION, *December, 1940*

With the aircraft industry seeking for large volume production, Tinnerman Products, Inc, of Cleveland, Ohio, step forward with their new speed nut fastener While speed nuts have been used on commercial airplanes for some time, they are now applicable for cowling control and instrument assemblies on government ships Molybdenum content is being used for overcoming fatigue stram and the tendency toward crystallization—AVIATION, *December 1940*

Throw a flyer and experienced radio man together, mix well, and you get the newly formed Air Safety Radio Corp, Armonk, N Y, producers of a miniature portable aircraft and entertainment radio This receiver is a pocket sized, 2 band set, 9½ x 4½ x 3, and is operated by earphones or speaker The set can be used by students for communication with the local control tower and solves the problem of communication with the weather bureau from hotel or other localities Company also manufactures new automatic radio compass operating on static free ultra high frequency wave lengths AVIATION, *December* 1940

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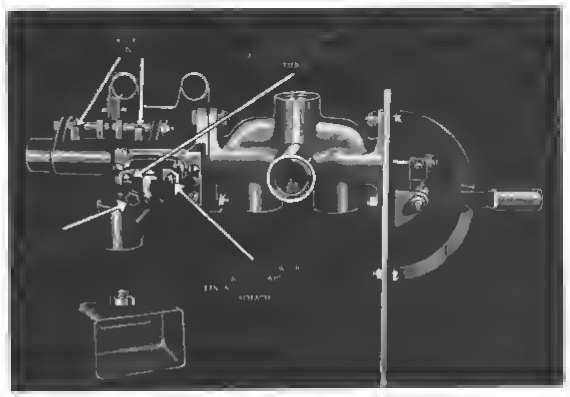
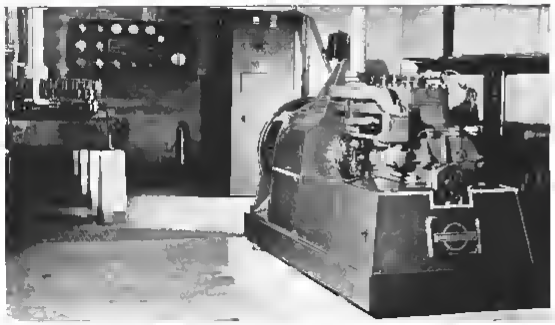


Hydraulic selector valve



Bardco 50 KVA emergency standby generating plant

Broadening their line to include fully automatic generating plants with capacities from 1 kw to 200 kw, and designating them as the "Master" series, the Bardco Manufacturing I Safes Co, Los Angeles, Calif, makes available stand-by power units of special interest to aircraft factories, airports, and radio communication stations. Features of the Bardco stand-by plants include three second "on the line" starting, a special voltage regulator developed by Bardco engineers, extreme compactness, automatic transfer and starting switches, special safety controls, etc.—AVIATION, *December, 1940*

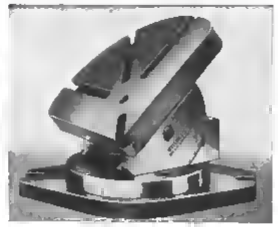
A machine tool fixture which provides for universal set-ups for drilling, milling and grinding machine is offered by the Wesson Co, Detroit, Mich. Known as the Wesson Universal angle plate, this device will help to extend the capabilities of existing equipment in many shops, thus helping to speed national defense activities where new universal machines may be on order but not yet delivered.—AVIATION, *December, 1940*

A streamlined filing machine, Type FA-18, has been announced by Grob Brothers, Grafton, Wis, builders of die making machinery. Standard throat size is 18 in but 30 in, 36 in., or larger throat machines may be obtained. The machine is only 60 in in overall height, occupies but 23x40 in of floor space, and has no exposed moving parts except where the files are passing through the working zone. A variety of types and sizes of files are carried in stock and special files are made to order—AVIATION, *December, 1940*

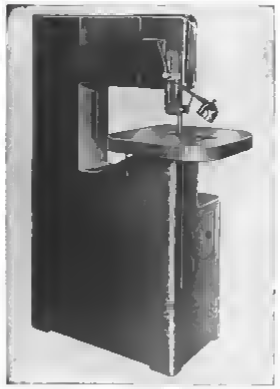
Lighter and more compact and portable than any previous sound-level instrument commercially available, a new decibel meter has been developed by Walter Mikelson and others of the General Electric Engineering laboratory, Schenectady, N Y. Weighing 19 lb, and having a range of 24 to 120 decibels, which is roughly from the rustle of leaves to the scream of a factory whistle, the new G E sound-level meter may be used for any sound-level study, including airplane cabin noise, engine or propeller noise, etc.—AVIATION, *December, 1940*

Latest arc welder improvement of interest to aircraft people is the automatic start and stop device introduced by the Wilson Welder & Metals Co, Inc, New York, N Y to eliminate the waste incurred from frequent idling of an arc welder between jobs. The device is for use on any magnetic starter motor generator arc welder which is driven by an a c motor. With the Wilson device the operator starts the welding unit by touching the work with his electrode holder. When welding is interrupted the machine automatically stops after a time delay which may be set between ½ and 1½ min, preventing undesirable frequent stoppings as in the case of a tacking job or similar work.—AVIATION, *December, 1940*

Designed as a companion to the ½ hp unit introduced last spring, the DeVilbiss Co, Cleveland, Ohio, is now offering a ½-hp portable air compressor unit for operating small spray painting outfits. Doubtless the new unit will find wide application for service work in small aircraft shops and hangars



Wesson Universal angle plate



Improved FA-18 Grob filing machine

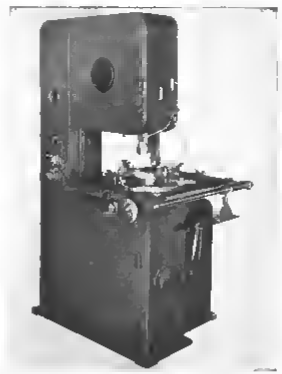
General Electric sound-level meter

Stop-start arc welder device

Type NKB portable air compressor

Searchlights at 800 000 000 cp

Goodrich flexible nozzle



Super DoAll

Encased in a streamlined housing, the new DeVilbiss Type NKB weighs only 72 lb, is readily portable and is equipped with four swivel casters.—AVIATION, *December, 1940.*

Searchlights so powerful that they make it possible to read a newspaper by the light of a beam originating 12 miles away, are now being supplied the U. S Army for anti-aircraft defense by the General Electric Co, Schenectady, N Y. The lights generate 800,000,000 cp and are fully portable.—AVIATION, *December, 1940*

A novel nozzle for gasoline hose use has been introduced by the B. F. Goodrich Co, Akron, Ohio. The Goodrich flexible nozzle is made of synthetic rubber and is so constructed that it discharges static electricity by providing a ground, thus preventing any dangerous sparks. A set of spiral brass wires are built into the stiffening ribs of the nozzle and extend to the metal coupling for discharging any static into the hose. The ribbed construction of the nozzle provides for complete venting of the filler opening, thus reducing "blow-back", permitting faster filling and avoiding waste of gasoline or dangerous splashing of gasoline over the airplane.—AVIATION, *December, 1940*

Added versatility has been built into the newest **DoAll** internal and external band saw and filing machine, known as the Super DoAll. Built by Continental Machines, Inc., Minneapolis Minn, the newest DoAll has a power work feed and mechanical control over curvature of the cut, completely eliminating hand guiding by the operator. This machine accommodates saws up to 1 in wide as well as the usual range of narrow saws used in contour sawing. Numerous other improvements and refinements are incorporated in the Super DoAll.—AVIATION, *December, 1940*

Developed for handling 1,000 to 3,000 lb. loads, the LT-40 lift truck is offered by the Towmotor Co, Cleveland, Ohio. Powered by a 22-hp four-cylinder gasoline engine, the LT-40 travels at speed of 1 to 10 m p h, with two speeds in each direction. A unique hydraulic lifting and tilting system makes it possible to lift and stack its rated load to heights of 7, 9 and 11 ft.—AVIATION, *December, 1940.*

Magnetic removal of iron and steel particles from oil flow is featured by the Frantz Ferrofilter, Model OP, designed by S G Frantz Co., Inc, New York City. Heart of the FerroFilter is a stack of strongly magnetized screens enclosed in a casing through which the oil flows. Catching particles as fine as 1/25,000 in, the screens nevertheless offer comparatively little resistance to flow and are non-clogging, allowing high capacity in small space. Weighing about 40 lbs, the FerroFilter Model OP has rated capacity of 20 gal/min requiring power of 115 volts D C. Height, center of inlet to top of outlet, 8¾ in, diameter of body, 6¾ in.—AVIATION, *December, 1940*

LT-40 Towmotor lift truck

THE Aviation NEWS

BLAINE STUBBLEFIELD, Washington | C. F. McReynolds, Pacific Coast | Jay P. AuWerter, New York | E. R. Lockin, New York | DECEMBER 1940

New Airplane Program Uses Auto Facilities

Will Nearly Double Fighter Output

Washington (AVIATION BUREAU)—The airplane production program is being increased—almost doubled as to combat equipment. The required manufacturing capacity is to be found by using the facilities of the automobile industry to produce parts and subassemblies, and by building new assembly plants in addition to presently scheduled expansion.

Behind this move are two factors. On the one hand is the administration's determination to give ever-increasing aid to Britain. On the other hand is Defense Commissioner Knudsen's uneasy feeling that the existing aircraft industry may not succeed in meeting the emergency. Knudsen returned from his tour of the plane factories convinced that airplane builders don't know enough about quantity production. The industry is now several hundred units per month behind the schedules originally set, and Knudsen is afraid they won't catch up.

To start a new program using different plants, different personnel, and perhaps different production methods, provides a hedge against trouble with the existing program.

The new program involves some 20,000 to 30,000 airplanes—depending on whether any trainers are included. This will be a standardized program restricted to three or four types. Planning has gone farthest as to the bombers. A four engine heavy bomber will be included; its design probably based on the Consolidated B-24, there will be 4,000 of these. Some 8,000 two-engine medium bombers will probably follow a design resembling the Martin B-27.

The pursuit type to be adopted is still in doubt, but the program will probably include about 8,000 of this class.

Of these 20,000 planes, the British will get 12,000, about equally split between pursuit and bombardment.

To the automobile industry has been assigned production of parts for these planes and of subassemblies running up to tail and wing sections. Idea is that general purpose machine tools can be made available by more intensive utilization of machinery now on auto production—free a press, for instance, by working three shifts on another press. In some cases it might even be worth while to incur the expense of periodically switching dies to get the use of a machine which is only needed part of the time. It is not thought that production of dies would offer any great problem, since the Detroit tool and die shops, with some 10,000 workmen, are now at a low level of activity.

Final assembly cannot be done in the auto factories, and new assembly plants are going to have to be built—perhaps as many as fifteen or sixteen—with British and U. S. funds. The plant expansions already planned cannot handle this added job, except in the unlikely event of complete rescheduling of the existing program, and the new plants will probably be in the Detroit area. Finding management for these plants is going to be difficult. It will have to be drawn from the aircraft industry, and the industry's executive and supervisory forces are already spread out so thin as to have an adverse effect on production.

All these problems are still in the survey stage. The auto firms have set up a committee which is organizing a permanent staff and finding out what facilities are available. This group will work with a committee of the aircraft industry.

Before the auto committee can go very far the objectives of the new program will have to be decided. It can be treated as an emergency program aimed exclusively at immediate production. In this case, the production methods of the airplane industry would probably be duplicated, and little effort made at real mass production. This is substantially what Ford is doing for P & W engines.

On the other hand, it may be decided to rely on the present program for immediate output and aim the new plans at the future, at building up a big capacity perhaps a year or more from now. This would imply some procurement of special purpose tools, re-study of production methods, probably some re-design to facilitate mass production, this last might go as far as substitution of stainless steel for aluminum sheet. All of this would take a lot of time but might increase output.

(*Turn to page 103*)

International

THE ARMY HAS RECEIVED THE FIRST number of the new Douglas A-20A light bombardment fighter plane shown here. Designed to combine the best features of the attack plane and of a light fast bomber from lessons learned abroad, the A-20A is an all metal, mid wing monoplane of monocoque construction. Carrying a crew of three, it is powered by two Wright 14-cylinder two row radial engines. Especially interesting is tricycle landing gear for easy landing on rough fields.

Acme

TO SPEED UP ACTION, a post of Deputy Chief of the War Department General Staff charged with co-ordination of Air Corps matters has been established. Maj. Gen. Arnold, Chief of Air Corps, (left) has been appointed to new post. Succeeding Arnold as Chief of the Air Corps is Maj. Gen. George H. Brett (right). They are looking at model of a new bomber.

British Get Bombsight? Best Guess Is Yes

Automatic Destruction If Nazis Get it

It wouldn't be cricket to print the dope on what is happening about the bomb sight, even if one should come by the information. But you can add up the reports and write your own opinion. Here they are.

There is no such thing as "the" bomb sight. The Army has one and the Navy has one. Both have variations. Not long ago, when the Washington "observers" said the United States had released to Britain an "outmoded" type of sight, which nevertheless is highly effective but not as accurate as the "secret" sight, they made a slight mistake. What the British got was the Army's latest sight.

This all stands to reason. The Administration, meaning the President, feels that the front line of the United States is across the water. He has tremendous public support in this opinion, to say nothing of the military. Is FDR, Commander in Chief of the Army, going to withhold anything he can give the British which might mean the difference between their success or defeat? Not likely, especially when Britain is only asking for the model from which to build her own.

The one reason why Britain should not have it, of course, is that the Nazis might get hold of it from a captured plane. The answer to this is reported to be an automatic bomb-mechanism which destroys the sight at the will of the pilot, or when the plane crashes. If this is not enough, your further pro-British argument is that no country has a monopoly on bomb sights.

Dropping projectiles from airplanes at targets is a science that is based on a few invariable principles. Every expert in that line knows them. It would be surprising indeed if, with the fate of nations depending to such a large extent on aerial warfare, one country could for very long outsmart the rest by a wide margin in bomb sighting.

Fly Wheat & Cement?

An air cargo showdown is coming nearer, step by step. When it will come is unpredictable. An air traffic rush coincident to the "emergency" might bring it on. Tough question for CAB is what to do about the Railway Express contracts with the airlines. Individual airlines could cancel, but it might be difficult to bring cancellation by all lines.

Everybody is interested in the "Selig Report," sponsored by the General American Transportation Corp., which warns the railroads that an airline-truck service tie-up would be disastrous for the rails. Those low air freight rates you hear about are not as silly as they sound. Glenn Martin has said there are planes on paper that can carry wheat at steamship rates, other good authorities say that, given ideal conditions, they could fly cement economically.

The railroads are deeply concerned; if such statements are only partly true, the air boys could rip the pants off the rail boys in the not far future. Some observers say that railroad financiers are quietly trying to save themselves by muscling in.

CAA Prepares To Build Airports

Selection of the airports to be developed with CAA's $40,000,000 appropriation is in the hands of Army, Navy, Administrator Connolly, and Major Lucius D. Clay, an Army engineer who has been made secretary of the approval board (Secretaries of War, Navy, and Commerce) which makes the final decision.

Plan is to build civil fields with military utility. It is not now intended that military units will be based at the field—simply that they will provide valuable auxiliary facilities. However, the needs of the Air Corps are expanding so fast that the CAA fields may be taken over as soon as they are ready.

Most of the limited funds available will be used to improve existing fields, though a few new fields will be built. The fields have to be owned by some public body, which must furnish land and build-inge and agree to maintain them. CAA contribution is limited to construction of actual flying facilities — runways, lights, radio, etc.

Army and Navy submitted lists of fields they would like to see built to Administrator Connolly. Working with Major Clay and local representatives, he has boiled the list down to a group of projects that can be handled with the money he has, and has submitted the list to the approval board.

CAA does not intend to set up an elaborate construction department to handle this work. It will choose the projects, set general standards, and turn over the actual construction to other federal agencies.

Build and Learn

During six years of instructing in aeronautics at the Rhode Island State College, Dr. Nicholas Alexander has devised a plan under which students build as they learn. Students turn out all sorts of models, embodying the aerodynamics they are studying, also build actual plane parts. The course is turning into one of the country's good laboratories of the air. They are building their own weather bureau for use in connection with CPTP participation. Regular credits are given for ground school work. The school is going to buy its own plane on which it expects students can take time at $2 per hour.

Pan Am Escadrille

Cuba and Ecuador got together recently and organized an Inter-American Escadrille, with pretty good results. Following up the idea, Nelson A. Rockefeller, coordinator of commercial and cultural relations between the 21 American republics, called a meeting at the State Department of several government heads, and outlined the plan. Everybody listened with interest while Mr. Rockefeller suggested $130,000 of federal money to provide planes and instructors for one year's training. Army and Navy men thought we should stick to our own training of men for defense and the airlines. But in back of everybody's mind was the need for some hemisphere flying plan to off-set the Nazi-Fascist attractions down there. Something may come of it, in some form or other. The National Aeronautic Association listened but said nothing, as yet.

AMONG THE HONORS recently presented in the aviation industry, special interest attaches to the Collier Trophy, awarded annually by the NAA and donated by the late Robert J. Collier. This year's presentation was to the airlines of the United States for their high record of safety, with special recognition to Dr. Walter M. Boothby and Dr. Walter R. Lovelace, II, of the Mayo Foundation for Medical Research and Education (l.) and to Capt. Harry C. Armstrong (r.) of the Army Medical Corps, for their contribution to the safety record through their work in aviation medicine and pilot fatigue. President Roosevelt will make the award at the White House.

SPOT CHECKING

C. C. Carlton, vice-president of the Motor Wheel Corp., has been made permanent chairman of the committee set up by the automobile manufacturers to organize plane parts production. William J. Cronin of the Automobile Manufacturers Association is his assistant.

Self-sealing tanks are now in production by B. F. Goodrich under a $2,000,000 contract to deliver orders in 60 days.

Heated flying suits, in which rubber conducts electricity contrary to Ohm's law, have been submitted to Air Corps for tests.

NAA criticises CPTP for paying such low instruction contract rates that civil operators training for Air Corps get the best instructors.

Model flying goins. 250,000 model fliers in 200 affiliates of Academy of Model Aeronautics (NAA) had 500 meets in past year.

Memphis-Springfield (Missouri) route was denied to Braniff, EAL and CSA; CAB said it was unjustified.

1000 Allison engines per month will be the production rate within a year, C. E. Wilson, GM acting president, predicts.

Beware of students pilots. Don't ride with them says CAB.

Aviation gasoline production is about 1,100,000 lbs. per month; domestic consumption 493,000, export 300,000, storage for future 350,000.

Kellett Autogiro occupies additional building in Phily; 85,000 more sq.ft.; has $1,000,000 in orders for flaps, tail assemblies, engine mounts—for plane companies.

Air base and other sites, under "destroyer deal" with Britain for use of Bermuda, Bahamas, Jamaica, Antigua, St. Lucia, British Guiana and New Foundland, have been agreed upon, and published by Navy.

Air mail pickup. All American Aviation, starts on Pittsburgh Williamsport, Pa., Dec. 2, snatching 11 route stations.

Italian planes are reported fueling at sea from new type submarine tanks, greatly stretching bombing range.

20 Boeing "flying fortresses" and Sperry bombsight go to Britain in a deal by which the British releases engines to equip 41 heavy bombers for the Army. Swap includes 26 Consolidated B-17C bombers now under construction.

Things Not to Do

Civil Aeronautics' rules for safe flying are three. (1) Don't stall; (2) Don't stall; (3) Don't stall. Here are some other things not to do. Don't take off with a faulty engine; a pilot did, and he and his passenger were killed. Don't disconnect things, especially the controls, and forget to hook them up again, a pilot did and he crashed. Don't neglect to inspect your controls; four pilots' sticks recently came out, and they crashed. Don't be overconfident, most beginners think they are good when in fact they are nothing but hams, a pilot took off with a faulty engine, it stopped, he passed over a good field, crashed in a poor one. Absent-minded folks should stay on the ground; a pilot forgot to turn his fuel valve full open, crashed, injured three onlookers and himself seriously. Crop dusting is a job for experts and for airplanes in a-1 condition; a duster, in a plane whose certificate had expired, was pulling pretty once at the end of the field, hit a tree, lost wing, dropped, killed. Don't watch one obstruction and forget another; a pilot, taking off, cleared some people launching a glider, hit a tree, killed a girl passenger and himself. There's a big batch of accidents every month; causes pretty much the same. Don't be a sucker for old tricks.

Air Education Flopped

Months ago the Office of Education outlined and proposed to initiate a program of instruction in aeronautical matters through the entire school system of the country. Sen. Pat McCarran introduced a bill authorizing such a program. Neither Congress nor the Office of Education has gone ahead with these plans. Both are criticised for this failure in a recent statement issued by the National Aeronautic Association.

Ten Flying Scholarships

For would be pilots who cannot get training through the CPTP or otherwise, the Volunteer Pilots Training Fund of New York, headed by Princess Ekatrine Obolensky, has raised a fund from voluntary contributors which is used to pay for flight "scholarships." The other day Stanley Howe, secretary to Mayor La Guardia, awarded the first ten scholarships. The fund managers expect to provide for a hundred students in all, to be trained under CPTP standards.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Strategic Waste of Time

When the time comes for airplane manufacturers to turn down civil aviation orders in favor of the military, they will let the Priorities Board break the sad news. Never offend a customer.

The bewildered layman, adding up expert testimony and the CAB report on the Lovettsville accident, concludes that lightning never bothers airplanes, but this time it did.

German pilots on Scadta got all the information they wanted before Pan American fired them.

The railroads are slowly fastening their tentacles on air transport, they've got to or lose their hides. Some onlookers say all present airline management will be forced out if it doesn't resist.

Air express packaging will be a problem. Stoppers will pop out, bottles will bust, cans will bulge, cats will collapse; and so will the management.

Bombing cities won't pay as well in future wars. Dugout living and working quarters will accommodate almost entire population. Military objectives will be scattered in the country. Destroying cities will be a strategic waste of time.

Commercial flying boats may be used less and less in future, even for overseas work, as adequate land port facilities become available at all cities for more efficient land planes.

Dr. Edward P. Warner's term as member of the Civil Aeronautics Board expires Dec. 31. We hear of no opposition candidates. Warner is vice chairman of the board.

The Stubblefield award is halved; to Britain, world's greatest seapower, for proving at Taranto that airplanes can sink battleships; and to American Airlines for a 3-page news release selling air travel on the fact that many of the Line's pilots are former football players.

Pickup-and-drop mail service on twelve routes serving 450 towns is in the works for New England. Several regular operators have intervened as All-American applied for extensions, but others say it will benefit the main lines.

The National Defenders in Washington are not only at peace on Saturday afternoon but they stack arms at lunch time *every* day. With few exceptions, for which we give thanks, they lunch till three and go home at four-thirty.

No Dock Chasing—Student flight behavior recording instruments have been developed by Dr. Brian O'Brien, director of the University of Rochester Institute of Optics. One electrically operated camera records the student's head, eye and foot movements; the other, synchronized with the first, makes a continuous record of the plane's instrument board, convex mirrors also throw in the position of the horizon for good measure. Instructor can check over the trip with student. This work is being done as an outgrowth of a program, sponsored by CAA, to study the visual reactions of students as compared with veteran pilots. This is probably all to the good but we wouldn't have liked it when we were a student and used to chase ducks off that lake near San Antonio.

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Might Be Forgotten

A Civil Air Reserve seems to be headed for realization As this was written, the CAA advisory group subcommittee was studying recommendations to be made to CAA. The National Aeronautic Association is very active in promoting the Reserve It is feared that during the emergency civil aviation will be all but forgotten by the government if it is not somehow organized for defense service One responsible airman told this writer it is easily possible "unorganized" private planes in upper power brackets might be commandeered if a serious war situation arose.

Intends to Serve

The new Aeronautical Advisory Council for the Commerce Department is getting down to business with a vigorous and apparently serious intent to serve Recently, a permanent organization was set up and bylaws adopted, whereupon the executive committee began appointment of subcommittees To these, which are created along functional lines, will be referred such problems as civil air reserve, airport expansion licensing of aircraft, and pilot training

Frank A Tichenor, magazine publisher, was elected chairman of the Council, Thomas A Morgan, president of Sperry Corp, first vice chairman, and Dr Clark Millikan, aviation scientist, second vice chairman In addition, the following were named to the executive committee Milton Knight, Edmund T Allen, William Burden, Casey Jones, Laurence Sharples, and John Jouett

Gravelly Point Delayed

Washington (AVIATION BUREAU)—Opening of the National Airport at Gravelly Point will be delayed till March Flying facilities are complete now, but roads into the terminal are still unsurfaced, and the buildings cannot be completed till spring. There will be no ceremony on Dec 17 (Kitty Hawk day) as previously announced Meanwhile the field is available for alternative use of transport planes, but so are both Army and Navy fields at Anacostia, just across the Potomac

Calling Names

D W Tomlinson, vice president TWA discussed high altitude flying before the *Herald Tribune* Forum.

Jacqueline Cochran, receives the Harmon Trophy from Mrs Roosevelt. This is third time she's won it

Railway Express announces the 10th anniversary of the first shipment of air express.

Thomas H. Beck, publisher of *Colliers* says war for the United States is inevitable

The International Sportsman's Show Chicago Feb 22 to March 2 is to have a display of sport planes and accessories for the pilot

C B. Allen, former vice chairman of the Air Safety Board will contribute regularly to *Western Flying*

Major Lucius D. Clay has been designated secretary of the airport approval board of CAA with offices in Commerce Building The board consisting of the Secretaries of War, Navy and Commerce is charged with responsibility for location of sites under the recent $40,000,000 national defense airport appropriation by Congress

F W Thrane and **D. C. Flynn** have been added to the staff of Luscombe Inc as general manager and sales manager respectively

George B Logan St Louis **William P McCracken Jr,** Washington and **Stanley T Wallbank** Denver have been named by NAA as a legal committee to advise the board and the general manager on legal matters.

Capt. Harold L. Neely, Air Corps received the Distinguished Flying Cross for disregarding his personal safety to make a crash landing in order to save three passengers who had already abandoned the ship

F C Arenstein, president of Java Pacific Line is now general representative of Royal Dutch Airlines for the US

Charles E Day, explorer and plane builder has returned to the US after six years in the Orient where he designed and built planes for the Chinese government

Earl C. Chatfield takes over management of Wilkening Mfg Co's Mid Western division with headquarters in Chicago **Ray Cooper** is in charge of special activities of the company in the West

F H Spencer, vice president of Spencer-Larsen Aircraft Corp has resigned from active management of the company to develop a special project in the aviation field Mr Spencer was one of the founders of the company

James B Weir was appointed controller general of supply for the British Purchasing Commission 15 Broad St, NYC.

L E Heisner resigned as general manager of Aviation Manufacturing Corp's Stinson Division to head Tennessee Aircraft Institute, newly formed Nashville corporation to train aircraft workers and manufacture airplane parts

Eric de Pencier, plant superintendent of Canadian Associated Aircraft, and **Miss M. D Day** of England were married in Montreal in November after Miss Day had made fourteen attempts to reach Canada. One delay was caused by the sinking of the City of Benares on which she was a passenger

C. A Gross, newly appointed assistant treasurer of TWA will be in charge of the preparation of statistical material

Peter Altman has resigned as director of the aeronautics department of the University of Detroit to become associated with Aviation Manufacturing Corp's research and development division at Detroit **Thomas Gerlach** executive engineer of Aviation Manufacturing transfers to Detroit to be associated with Mr Altman

Dr Joseph W Barker, dean of Columbia University School of Engineering has been named regional adviser for New York and Long Island in the Federal program to train men for engineering jobs in defense industries.

Harold Kandolf has resigned from Aviation Manufacturing Corp to become treasurer of W L Maxson Corp manufacturers of military and navigational apparatus

Dr Max Brennan is to assist **Dr Ralph Greene** director of Eastern Air Lines' new medical department

At Lockheed Aircraft **Robert Harlow** has been appointed head of field service **George Kiye** in charge of customer information **Roger Lewis** general purchasing agent for both Lockheed and Vega Airplane

Irving B Babcock president of Yellow Truck and **W. A. Brown,** president of Briggs Manufacturing were added to the automotive industry's committee to correlate activities of the automotive industry and the aircraft industry in tooling and production of aircraft. **C. C Carlton,** vice president of Motor Wheel Corp is in charge of committee's office in Detroit

Harold R. Thomas, vice president of Elastic Stop Nut Corp has resigned to engage in consulting work He is still a director and member of the executive committee of the corporation

Canada's Air Marshall **William Bishop,** World War ace, spoke on the RAF at a dinner under the auspices of the Canadian Legion in New York City on Nov 25

Canadian Aviation News

By James Montagnes

Canada is to start at an early date to manufacture airplane engines The Canadian Ministry of Munitions and Supply is now negotiating for plans and specifications of a British engine and the right to manufacture it in Canada So far all engines used in airplanes built in Canada have been imported from Great Britain and the United States

It is understood that Canadian airplane factories have started work on the new four engined British Stirling bombers Production of twin-engined Handley Page Hampden bombers in Canada will soon reach 15 monthly, according to Paul F Sise, president of Canadian Associated Aircraft Ltd, the central assembly organization handling certain British government war orders

The Royal Canadian Air Force has a new flag, differing from the Royal Air Force flag with the substitution of a maple leaf in the white inset of the flag for the red circle in the inset

The first large group of fighting pilots trained under the British Empire Air Training plan was graduated on September 30 at Camp Borden, Ontario. The group contained pilots from all parts of Canada, the United States and the West Indies

Trans-Canada Air Lines, the publicly owned transcontinental airlines has been given the right to fly from Toronto to New York This gives Canada a 15 hour service from New York to Vancouver against a 16 and 17 hour service from New York to the Pacific coast provided by United States lines with present equipment. T C A carried nearly three times as many passengers during the first eight months of this year as in 1939

A civil aviation report of the Department of Transport for the first six months of 1940 shows that on June 30, 1940, there were in Canada 781 private pilots, 153 commercial pilots, 244 limited commercial pilots, 142 transport pilots, 762 air engineers, and 22 airport traffic control officers At that time there were in use 64 private airplanes, and 103 airports were licensed. Private flying clubs during the first half year flew 21,518 hours with 104 planes, surpassing in the half year every full year except 1939 There were 2,201 members in the 21 clubs

NEW EDO PLANT going up at College Point, L. I. From war experience abroad, the design incorporates latest knowledge for camouflage bomb resistance and blackout (See story p. 104)

Air Corps Reorganized; Ranks with Field Army Lieut. Gen. Delos Emmons Commands GHQ Force

Washington (AVIATION BUREAU)—Development of the Army Air Corps into the most powerful aerial striking force in the world has begun A momentous reorganization is now underway, designed to create maximum mobility and administrative efficiency, while maintaining the air force within the structure of the U S Army to allow complete coordination of air and land operations

Over the past month these major changes in Air Corps set-up were announced Maj Gen. H H Arnold was made a deputy chief of staff, assuring the Air Corps of representation on the general staff by an officer thoroughly familiar with aviation requirements Here he will serve as liaison officer in matters of policy and special Air Corps problems Maj Gen George H Brett was appointed acting chief of the Air Corps, replacing General Arnold His duties, however, will be confined primarily to procurement, research and training only For simultaneously, the combat air force was removed from the jurisdiction of the chief of Air Corps and returned to the general staff, with appointment of Delos C Emmons as Commander of the GHQ Air Force with the rank of Lieutenant General, the same as that of the commanders of the four other field armies This move places the fighting air force under centralized command along with other branches while at the same time relieving the combat commander of procurement and training problems

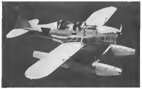
This alignment of the air force obviously is intended as a compromise between the determined partisans of a separate air arm and the Air Corps as it was The Administration had been studying the problem for a long time, but was hurried by the opposition, which, during the election campaign, advocated not only a separate air branch but a cabinet office for aviation

Meanwhile, the GHQ Air Force is being reorganized into four Air Districts—northeast, southeast, northwest and southwest—and three overseas departments—Hawaiian Department Panama Canal Department and Puerto Rican Department Each of these is under the command of a major general

The four Wings now existing are being increased to seventeen Wings, fourteen to be divided among the continental Air Districts and three to provide one Wing each for the overseas departments The seventeen wings are expected to comprise 54 Combat Groups by the time the Air Corps expansion program is completed during 1942

Under current War Department policy, each Wing will be made up of from 55 to 250 of the same type of planes together with complementary ground units Thus for example, a Wing might comprise 250 pursuit ships, plus the required weather, communications and reconnaissance facilities and mechanics and other air base services

'PATIENTS' shown inside the Army's newly-developed cargo transport plane after its conversion, within 20 min., to a flying ambulance



HERE IS THE FIRST of the Ryan S-T training planes to be equipped as a seaplane for Navy pilot instruction A twin float seaplane, the Ryan trainer has 150 hp engine and is of metal construction.

Navy Orders Blimps

Washington (AVIATION BUREAU)—Lighter-than-air ships can drift about night and day, saving their fuel, float downwind quiet as a cat upon any mischief that may be afoot. There is nothing like them for patrol

Congress authorized 48 blimps (gas bags with no frames) along with the Navy airplane program Few days ago Secretary Knox announced at press conference that $1,324,000 had been awarded to Goodyear, the only bidder, for patrol and training blimps The patrol ships will be 246 ft. long, 123,000 cu ft Number of units is secret, but a reasonable guess might be a couple of trainers and four or five patrols It is not known when the balance of the 48 will be ordered

Navy officers have been inspecting lighter-than-air base sites in Florida Lakehurst will be continued Presumably the intention is to patrol the Atlantic Coast from these two spots. Whether any of the 48 blimps, when delivered, are destined for the Gulf and the Pacific Coast is speculative The Navy still has authority to order a $3,000,000 dirigible, for training purposes, which would carry and release airplanes, but it is doubtful if this will be done while the pressure is on for 15,000 airplanes

GRACE OF A GULL and power of a hawk are united in the Douglas 8A-5 attack bomber Powered with 1,200 hp Wright Cyclone, the 8A-5 carries substantial bomb load and armament of seven machine guns Note perforated wing flaps

No Fuel Storage

Storage of high test aviation gas for a rainy day has been at least temporarily stymied by inability of Army, Navy, and RFC to get together on long-term commitments Plan, worked out some months ago by Defense Commission, was for refiners to operate steadily at capacity and store the surplus at government expense RFC organized a $50,000,000 subsidiary corporation to handle the program. Legal red tape and unwillingness of Army and Navy to agree far in advance to take the fuel from RFC caused trouble For the present the military will rely on their own storage

First Deliveries On Advanced Models

First deliveries were taken in the last month by the Air Corps on a number of the new high type airplanes. The first of the service test group of Republic's P-43 was received. This is a more highly powered and generally improved version of the P-35. It is one of the few pursuit ships with an air-cooled engine which can show performance comparable with the new Allison powered jobs. This ship was ordered under last year's 5,500-plane program, but about 1,000 of substantially the same airplane are included in the present program.

Also ordered under the 5,500-plane program is the Douglas attack bomber, A-20A. First deliveries of this two-engine ship are just being received. Some 400 of these are ordered in the current program.

First of Boeing's improved flying fortresses, B-17C, were delivered a few weeks earlier. This is the model incorporating powered gun turrets. About 500 have been ordered under the 19,000-plane program.

The improved version of the Curtiss P-40 pursuit, the P-40D, will start taking the air this month. This is more streamlined (the pilot reputedly uses a shoehorn to get in), and has a higher-powered Allison engine than the P-40. About 1,750 are on order.

First Bell Airacuda with tricycle landing gear, the FM-1A, has been delivered for service test. This is a five-place fighter powered with two Allison pushers and mounting cannon. This is the last of thirteen Airacudas on service test, but they are not expected to have an important place in the new program.

Swedish Orders Assumed By U. S.

First application of the Fadis bill, permitting the President to requisition foreign owned defense products held at the docks by failure to obtain an export license, was the seizure of 110 Republic airplanes still undelivered out of a 131-unit Swedish order. Fifty pursuit ships had been finished and stored in circus tents on Long Island; 60 light bombers, essentially the same ship, are still in production. These airplanes, the same ship as the Air Corps' bumblebee-like P-35, are already obsolescent as far as fighting is concerned, but are very valuable for advanced training particularly the 2-seater bombers. The Swedes, under heavy German pressure, refused to sell, necessitating the requisitioning. In deference to Nazi-Swedish relations, the ships are being turned over to the Air Corps rather than to the British. It is likely, however, that the Army will turn over a like number of P-25s to Canada.

Next in line is the Swedish order for some 150 Vultee Vanguards, none of which have been completed yet. Vultee has already agreed to deliver these to Britain and is being sued by Sweden for breach of contract. Since these are high-performance fighting ships, it is unlikely that we will show the same delicacy over Swedish susceptibilities.

Expect New Taxes

Even before the recent tax law was finally enacted Congressional leaders hinted that Congress would pass a new one next session. This prediction now seems a certainty, and has been officially confirmed by Rep. Robert L. Doughton (D., N.C.), chairman of the powerful House Ways and Means Committee, who anticipates a thorough review of the tax situation in the hope of increasing federal revenues to aid in financing the defense program.

The amortization section of the second revenue act will not be materially affected, however, according to present indications, as officials realize the resulting havoc major changes would work on the defense production program.

New Plane Program

(Continued from page 97)

If the latter course is adopted, the final result might be some such set up as that in Germany, where one branch of the industry develops and tests new models, while another grinds out standardized types. It might also segregate the excess capacity of military needs over civil into a few government-owned plants which could be held in standby condition when the war's over.

A MASS DELIVERY of 40 Republic P-35s single-seat fighters starts on first leg of journey to the Philippines. Originally produced for the Swedish Royal Air Force, they were requisitioned for National Defense.

British Receive Most Fighters

The President says he has a rule of thumb by which U.S.-built armament is split 50-50 with the British. But as regards combat airplanes, they have already been allocated about half of the scheduled output for the next year and a half. Moreover, they are now getting delivery on almost our entire *present* output.

Of the 25,400 combat ships now scheduled for July 1942 delivery, nearly 12,000 will go to England. The remainder are split between the U.S. services, 8,200 to Army and 5,300 to Navy. The British also receive 2,400 trainers out of a total of 10,400, of which the remainder will go 6,200 to Army and 1,800 to Navy.

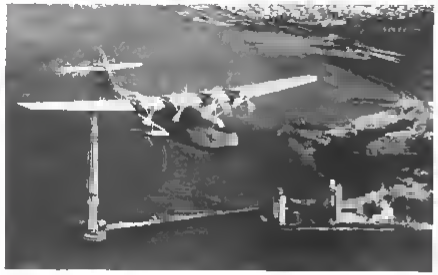
If plans to increase the combat program by 20,000 go through, the Britishers will be getting 26,000 fighting ships out of a total of 45,000.

Fly Away Bombers

Fly-away delivery of bombers to Britain will be tried on a substantial scale this fall. So far not more than four or five ships have been flown across. However, about 50 Lockheed Hudson two-engine bombers, which were completed recently and turned over to the British, were held in this country pending installation of radio equipment. They were to be flown across as a real test. What has prevented more flights previously is that so much work has to be done in the way of installation of extra gas tanks in the bomb bays and flotation gear (inflatable safety pontoons) in the wings—at least as much work as the partial disassembly and reassembly involved in ship transport. But it is now becoming increasingly difficult to arrange transport, some shipments waiting a month or more for a ship. Unless serious losses should result from the first flights, this factor plus the freedom from submarine hazards, is likely to mean that nearly all the larger ships will be flown next spring.

Stearman Plant

Construction has begun on Stearman Aircraft's $3,500,000 factory at Wichita, Kan., which when completed will add 4,000 men to the Stearman payroll. New plant will be saw-tooth type, ¾ mile long.



Clipper's 5th Birthday

Five years ago November 22 Pan American's Martin-built China Clipper, followed shortly by the Philippine and Hawaiian Clippers, blazed the Pacific air trail to the Orient Celebrating the fifth anniversary, Glenn Martin Company announces that the China and the Philippine (the Hawaiian was lost at sea) have piled up some 10,000 hours apiece, or an average of 5½ hours a day since they left the factory, a performance record "unequalled by any other plane ever built." Total miles in the air of the two ships is 3,000,000, passenger miles 12 718 200, express and mail, 1 000,000 Designed to carry 12 sleeper passengers or from 32 to 43 day fares, hesides mail and express, the Martins surprised everybody by getting licensed to carry 102 1 percent of their dead weight. They trained in speeds of 181 mph top, and 157 mph cruising Mr Martin says that when peace returns the things we are learning now—how to build bigger and faster airplanes which will carry heavier loads—will be applied to great flying boats that will establish e commerce we have not yet dreamed of

New Edo Plant

Having special raference to experiences of wartime Europe the new Edo Aircraft plant, to be built at College Point, Long Island, is designed for three purposes camouflage, bomb resistence and blackout

The roof and portions of the sidewall are so designed that they can be readily covered with a material placed to break the building's straight lines For further concealment, the steel sash and glass of the side walls will be placed in a slanted position so the glass will deflect the sun's rays downward

Reports from abroad indicate that buildings best withstanding bombing effects are those with sturdy steel frames and the most flexible possible exterior shell These experiences are incorporated in the Edo design which is expected to result in a minimum amount of damage to the structure if blown out

Experience, designers for Edo believe, has also shown little can be done to protect adequately from direct hits, and as the cost of a windowless building is more than double that of a structure with windows, the windowed type was decided upon Also, as the utility lines leading to the factory may be destroyed, a windowless plant would be left inoperative, whereas independence of artificial lighting would afford at least 10 to 12 hours production (See photo p 100.)

Champion High Jumper

Pitcairn's new jump takeoff Autogiro, the "Whirl Wing," recently was demonstrated by pilot Fred Soule before Army, Navy, Coast Guard officials at Washington airports. In lively headwinds the machine extended its normal vertical jump of 25 ft into a practically continuous ascent. Also interested are the Department of Justice border patrol and the Department of Agriculture, which has long used giros in surveys and plant quarantine CAA and NACA witnessed the tests at Bolling field.

Beech Expands

By April 1 Beech Aircraft will have an additional 425,000 sq ft. of factory space and about 4,000 more men working in Wichita, Kan. A federal facilities contract started construction on two assembly and two parts fabrication buildings, a delivery hangar and an extension on the present office building The new structures, costing $2,384,000, will be used at first to complete Beechcraft's $22,000,000 government order for twin-engined trainers

Windshield Wiper

A newly designed windshield wiper will soon be placed in service on all Flagships of American Airlines Developed by the Aerotorque Co., of Cleveland, in cooperation with American's engineering dept, the wiper operates on hydraulic pressure available from the hydraulic accumulator It is made of non-magnetic materials, weighs 6¾ lb and develops up to ¾ hp., using 300 lb. of pressure The wiper operates on both the right and left glasses of the windshield simultaneously, and has provisions to feed alcohol for deicing in winter flying

Miami Gets Plane Plant

Plans for Miami's first large airplane factory, to be built and operated by Intercontinent Aircraft Corp, have been announced The main plant will have 100,000 sq. ft of floor space. In addition, the company will build an office and engineering building, woodshop, paint shops, and warehouses, at a total cost of $750,000

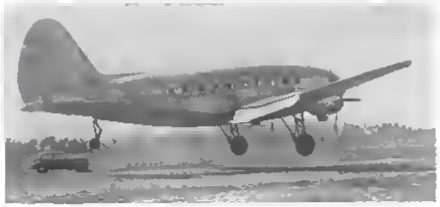
Intercontinent, headed by William D Pawley, now operating aircraft factories in Chuns and Los Angeles, will make a low-wing, all-metal military trainer. The model is being tested by the U S Army and negotiations are also under way for orders with the Navy and the British Purchasing Commission.

United Backlog

With more than 300 employees now on the payroll, and a backlog of aircraft parts orders exceeding $1,035,892, the United Aircraft Products, Inc, Los Angeles, is materially expanding production facilities and adding to personnel Additional orders for $700,000 of aircraft parts machine work were received in October and further substantial business was in prospect

Lear Offices Transfer

Transfer of the office force of Lear Avia, Inc., to the Rubicon Bldg, 38 North Jefferson St, in downtown Dayton has been announced The vacated offices in the Lear factory are to be used for additional production and engineering facilities



FLIGHT TESTS have been resumed on new 36-passenger Curtiss-Wright transport after undergoing a few structural changes

MAJ. GEN. ARNOLD gives the Army low-down on the spark plugs of the Glenn L. Martin Co. Center is Glenn L. Martin, J. T. Hartson, executive vice president (left), and H. F. Vollmer (right) vice president in charge of manufacturing at the factory. Company is under way with what is expected to be fastest medium bomber in world.

Assembly Lines

Curtiss P-40s are rolling off the Buffalo assembly floors at a rate of about eight a day All are going to Britain Construction of an additional 1,200,000 sq ft plant will be complete in May and production underway by mid-summer

Upper limit on P-40 production is output of Allison engines, reported still under 200 a month Substantially all are now going into the Curtiss pursuits but when Bell's Airacobra and the Lockheed P-38s (a two engined pursuit) get into production there may be trouble

Boeing is turning out a flying fortress four-engine bombers every two days Here also plane output is ahead of engines, with completed ships waiting for engines Boeing has completed an arrangement with Iron Firemen Mfg. Co to devote its entire Portland plant to subcontracts for landing gear, forgings, and castings for bombers.

Piper cubs are now being produced at a rate of 400 a month Early completion of new buildings will step this up to 500, and plans are being worked out for an 800-cub a month production

Pratt & Whitney engine output, including spares, is approximating 900 units a month

Waco is building 90 PT 14 trainers a month for use in the CAA secondary training program These are all being sold to flying schools

Stearman primary trainers are being turned out one every three hours of a two shift day at Boeing's Stearman division in Wichita By January it is hoped to double this rate

The Martin 187, the two-engine medium bomber soon to go into production for the British, will be known as the Baltimore.

Douglas' new Long Beach factory will be purely an assembly plant. All parts manufacture is being subcontracted, mostly to auto body firms—Murray, Briggs, and Fisher Parts will move to Long Beach in 50 specially designed box cars with built-in racks

Interstate Aircraft & Engineering Corp., Inglewood, Calif, is now under production on the Cadet lightplane trainer recently announced Substantial additions have been made to factory facilities and a production rate of 600 planes a year is the present goal The first plane off the production line was flown early in November and additional planes are currently being assembled at the rate of about two a day

Diesel aircraft engine manufacture has been temporarily pigeon-holed by Gulberson Diesel Engine Co. Gulberson engines are built under agreement, by Ends Co Bude's facilities are now entirely tied up in radial diesels for tanks of which eight a day are scheduled to be turned out starting first of the year

Aluminum ingot price dropped 1 cent Nov 18, to 17 cents a pound

Boeing's Seattle plant will be nearly doubled in size with a new expansion of about a million square feet bringing Seattle area to 2,500,000 At the same time the Stearman trainer division plant at Wichita is being increased about 600,000 ft. to 735,000 Most of the Wichita increase will be devoted to sub assembly for bombers, but trainer output space will be increased to 200,000 sq ft The $10,700 000 cost of expansion will be paid by the government under a "bunkhole contract" plan

Government financing of a $4,295,000 expansion of Vultee has also been contracted for Simultaneously contracts have been made for a $1,023.000 Bell expansion and a $1,620,000 expansion of Beech Aircraft. In all these cases the company obtains the money privately and is reimbursed over five years by the government. At the end of that time, the government takes title, but the company may buy the plant at depreciated value if it wishes

Hamilton Standard propeller division of United has leased a 200 600-sq ft factory at Pawtucket, Conn It will be used for manufacture of blades and assembly of hydromatic propellers.

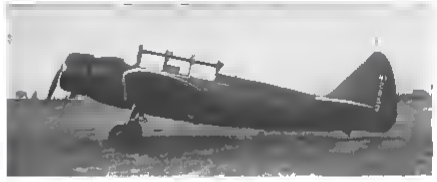
Wright Aeronautical has leased a 433,000-sq ft. plant at Paterson, N J, to be used for machining cams and gears and for storage This brings Wright's Paterson facilities to a total of 2,800,000 ft.

Air Associates have started construction of a $200,000, 50,000 sq ft plant at Los Angeles Municipal Airport, doubling the company's West Coast parts manufacture.

The Timm Aircraft Corp., Van Nuys, Calif, reports receipt of an order from Vultee Aircraft of approximately one million dollars for airplane parts and accessories This brings the backlog of Timm parts business to well above $1,000,000 The present staff of approximately 150 workers is to be increased to 500 as rapidly as possible

Early in November the backlog of Northrop Aircraft, Inc, had jumped to more than $25,000,000 and the payroll was more than 1,500 persons. Work now under way includes Northrop patrol bombers for the Norwegian government, aircraft components for Consolidated and Boeing About $1,500,000 in orders for the U S Army and Navy And a $17,000,000 order to build complete aircraft for Great Britain During 1941 it is planned to increase payrolls to more than 5,000 employees in an effort to boost production of light bombers to a rate of two a day.

Menasco Manufacturing Co. is now located in its new factory in Burbank, Calif, and is reporting a current production volume of about $200,000 per month Major Menasco engine production is now centered on the new D-4 model of 125 hp



THE WARNER-POWERED FAIRCHILD trainer equipped with cockpit enclosure now undergoing flight tests New need extensively by operators in the Secondary CPT Program, this model is powered with a Warner 165 hp engine

UNITED AIRLINES new $200 000 operations building and hangar at mile square Portland Columbia airport in Oregon Included are offices for flight operations, radio, meteorology and reservations, plus large modern commissary

Employment at Lockheed Aircraft Corp. hit a new all time high when the personnel department reported 14,312 persons on the payroll as of Nov 1 These figures do not include 2,500 employees of Vega Airplane Co., a subsidiary of Lockheed Personnel training has greatly eased the problem of adequate supervision and soon after the first of the year there will be a total of 1,365,405 sq ft of factory and office space operating on a 24 hr schedule This figure represents an expansion of 529,000 sq ft and does not include the new $3,500,000 Vega factory of 229,000 sq ft area now nearing completion on Union Air Terminal

Vultee Aircraft, Inc., has continued expansion at a rapid pace with a new extension to the factory recently completed and a further $4,294,798 construction program about to start. A new north-south runway has been added to field facilities Factory employment is currently around 6,000. Production of the Vultee basic trainers for the U S Army is progressing at the rate of about five a day Thirty three planes were flown away on Nov 9 in a mass Army fly-away to Moffett Field, Calif

AVIATION ABROAD

U. S. AND ENGLAND have ordered 1,599 of these fast Bell Airacobras. A new factory is being built to construct them and Bell plans rapid line production methods. The ship is powered with eight guns, and a 37mm. cannon.

THE DOUGLAS (BOSTON) D-B 7, one of new American aircraft types recently inspected by Duke of Kent in England. The Boston is a twin-engined light bomber with deep narrow fuselage curling up towards tail and tricycle undercarriage.

News comes from South America that the latest attempt at expansion by the German-owned Condor system is on agreement with the Brazilian steamship company "Snap", which serves the upper reaches of the Amazon. Just what the results of this move will be, remains to be seen. However, it strongly indicates that further attempts to open new markets and obtain further control of transportation in Latin America will be made by Nazi Germany.

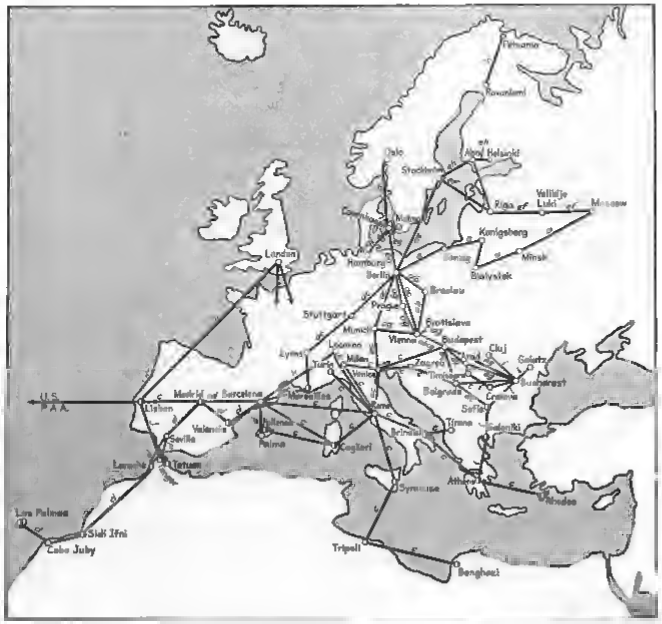
In this connection it is interesting to note that an attempt by the German Lufthansa was recently announced to start an airfreight service between Europe and Rio de Janeiro, or Buenos Aires. They will undoubtedly use Air France's base at Dakar, with this line's ground facilities.

A NEW FOUR-ENGINED BOMBER built by Consolidated Aircraft for Britain's Air Force. Large numbers of these planes are under construction at San Diego and will probably be flown across the Atlantic. The planes can carry four tons of bombs at 300 m.p.h. for 3,000 miles nonstop. Camouflage and RAF markings are already painted on as the bomber is prepared for test flight.

EUROPEAN AIRLINES
OPERATING ON OCT. 1, 1940

(a) Deutsche Lufthansa A.G., Germany
(b) Malert, Hungary
(c) Ala Littoria & Avio Linee Italiane, Italy
(d) Iberia, Spain
(e) Ab Aerotransport, Sweden
(f) Aeroflot, Russia
(g) Det Danske Luftfartselskab, Denmark
(h) Aero. O/Y, Finland
(i) Lares, Rumania
(j) Aero Portuguesa, Portugal
(k) Swissair, Switzerland
(m) British Overseas Airways, England

With the disruption in the Balkans, some airline services have been altered since Oct. 1. One of the most important developments in the international activities of the German Lufthansa is the extension of the recently established Berlin-Madrid airline into Portugal to Lisbon.



ON SCHEDULE

by "VISTA"

On the page opposite will be found a map of the airlines still operating in Europe around the first of October. Now that war has actually come to the Balkans, many of the lines naturally will disappear, the latest reports already indicate a strong curtailment of the air services in and around Rumania. However, it will still be a surprise to many readers that so many connections are still being maintained in these times.

The services from England, with the exception of the connection between London and Lisbon, are problematic, no confirmation can be obtained whether there actually are services available to either South Africa, India or Australia, though Durban and Sydney are connected through a 20,000-mile "horseshoe" service. This line could be reached from London, at least for mail and a few official passengers, at Alexandria, Egypt. As there are planes available in England which are able to fly the distance England-Egypt nonstop, with a fairly respectable load, a connection does not seem improbable.

A new company has arisen in Spain, known as the T A E (Transportes Aereos Espanoles), which apparently is destined to take the place of the old 'LATE", once Spain's foremost representative in international air-traffic, and a user of American Douglases. Present services are being operated by the "IBERIA" on a very limited scale, while it is very doubtful whether any Spanish lines will attain prominence under the present circumstances, when equipment, personnel and fuel is scarce.

Much belated, traffic results from some of Europe's major airlines are now coming in, from only one of these reports can the influence of the war, even during the relatively quiet first four months, be gathered. The other figures just show the effect of the war by the exceedingly small gains, if any.

The effect of the war was even felt in the Far East, where the year report of the KNILM Royal Netherlands Indies Airways, shows a gain of only 103 passengers over 1938, with a 21,075 total for 1939. Small increases in freight and mail are also reported, working out at 14 percent approximately.

The Swedish ABA gives the following figures for its operations: passengers 48,029 (46,845), mail 1,270,000 lb (1,574,000 lb.) and freight 2,468,000 lb (2,230,000 lb.)

The French airline, Air France, shows a drop in passenger traffic of 12½ percent to 91,469, mail dropping 40 percent and freight 8 percent to 1,775,000 and 1,900,000 respectively.

As mentioned before, there is one complete report showing the direct influence of World War II, Holland's KLM Report is divided in two parts, results for the first eight months of 1939 and the last four war months. The results of this airline's South American system are given seperately, as they were not so directly effected.

During the first eight months, results, compared with 1938, were as follows: passengers 110,800 (103,700); freight 3,480,000 lb (2,751,000 lb.); mail 1,600,000 lb (1,572,000 lb.)

With the outbreak of the war, services had to be curtailed as much as 75 percent, and the results show a corresponding drop. Passengers fell from 49,670 in 1938 to 12,815, while freight and mail figures fell an average of 50 per cent.

Only the West Indies services show a favorable report for the fateful year 1939—passenger traffic increased 46 percent to 13,299, freight 42 percent to 248,000 lb. and mail went up 50 percent to 21,000 lb.

Systemwide, the results of the KLM, apparently ameliorated by the fact that the first eight months were better than ever, and the steady improvement in South America, indicate only slight losses in passengers and freight of 16 percent and 7 percent respectively, while mail showed an increase of 6 percent over 1938.

GEORGE F CHAPLINE has resigned as vice president of Wright Aeronautical to take over the presidency of Brewster Aeronautical. James Work, former president, is chairman of board.

Major executive changes have been announced by Wright Aeronautical Corporation. Following the resignation of George Cheplne as vice president and sales manager, William D. Kennedy, (l.) service manager for the past 12 years, was appointed to succeed him as sales manager. Mr. Kennedy had previously been with the Air Corps, for whom he had installed its present inspection and maintenance systems. Philip B. Taylor, (l.c.)

with Wright since 1922, latterly as chief engineer, is promoted to assistant general manager and will work closely with Myron B. Gordon. Raymond W. Young (r.c.) advanced from assistant chief engineer to chief engineer, started with Wright as test engineer in 1925, and was the winner of the Manley Medal in 1937. P. W. Brown, (r.) general superintendent, has been made assistant works manager, and will devote time to manufacturing problems.

MERRILL C. MEIGS, publisher of the Chicago Herald American, was appointed head of the aircraft division under National Defense Advisory Commissioner W. S. Knudsen, replacing Dr. George Mead

NEW Assistant Administrator of Civil Aeronautics is Charles I. Stanton, for twelve years a key executive of the Federal Airways System. Arlin E. Stockburger is named Administrative Consultant

A. FELIX DU PONT, JR., president of Elton Investment Company, vice president of All American Aviation, and test pilot, has been elected a director of the American Export Airlines.

BYRON W. SKILLIN has been appointed traffic manager of All American Aviation, to develop the company's traffic program and its plans to extend pick up service through New England

ACCORDING to official NAA barograph reading, Grace Huntington reached 24,311 ft. in her 65 hp. Taylorcraft on Sept. 13 (not 22,700 ft. as first read) establishing a world's record for light planes.

JOHN B. WALKER, regional traffic director of United Air Lines, is president of Airlines Terminal, Inc., which operates the Airlines Terminal in N.Y.C. C. A. Miller is v.p. and W. S. Allen, secretary

E. R. PERRY has been appointed to the newly created post of executive assistant to President P. G. Johnson of Boeing Aircraft Co. For past three years he was a management executive with Talon, Inc.

THE DANIEL GUGGENHEIM MEDAL for 1940 goes to Glenn L. Martin for "contributions to aeronautical development and the production of many types of aircraft of high performance."

FRANK F. RUSSELL, president of National Aviation Corp., was elected a director of the Bank of the Manhattan Co. He is also a director of National Aviation, Lockheed Aircraft and Bell Aircraft.

TD TRAIN 8,000 new employees, Republic Aviation separates employment and personnel activities. Philip R. Shaye (above) becomes personnel director; S. E. McMurtrie employment manager

Lockheed's New Photo-Loft Process

A new photo-loft-template process worked out by Lockheed Aircraft is expected to so accelerate plane production that it will be possible to shorten the time between engineering and test flight by from two to four months. The new equipment consists of two huge cameras, one 34 ft long and equipped with one of the largest photographic lenses ever made, the other standing 10½ ft. high and mounted on a derrick arrangement with the camera pointing straight down.

The latter camera is used first, in the loft, where a picture of the engineer's drawing is taken. The camera is fixed focus, set for one scale (¼) reduction, and all adjustments are "safetied" and stay put. The focus is checked every two weeks, a set-up which permits pictures being taken by a loft man who is not a photographer.

After the picture is taken in the loft, the plates go to the photo department for development, and then are put in a special camera and projector. The giant camera projects the reduced scale negative back to the full size on sensitized metal prints. Immediately subsequent to making the projection on the sensitized metal, another is made on sensitized tracing cloth which provides the means for making blueprints. The metal plates are cut out and become the templates that go to the shop, while the tracings are sent to the blueprint dept.

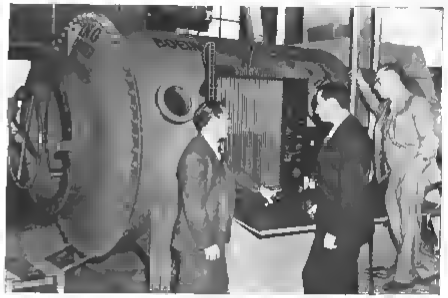
In the past each template had to be laid out manually. The main function of the new system is to eliminate this manual duplication of effort, which has been the bottleneck between released engineering information and the finished parts and tools manufactured.

Engineering Feat

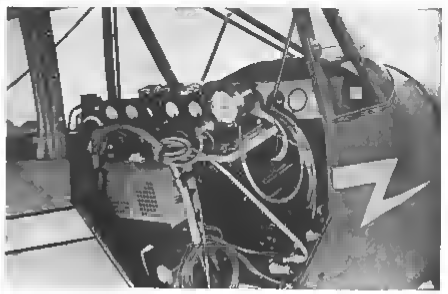
Details of a spectacular engineering feat by which the center section of the giant Douglas B-19 Army bomber was moved from its assembly cradle and mated with the nose and tail fuselage sections have been revealed. Climaxing several years of secret construction work in the closely guarded Douglas final assembly hangar, the mating operation was so huge that it was directed by experienced bridge builders. The 80 ton B-19 was built in three main sections, the center portion of the fuselage being constructed integral with the center section of the wing. To complete the structure it was necessary to unite the three portions of the fuselage. The section to be moved weighed 34,000 lb so a complete preliminary dress rehearsal was staged with electric winches operating through pulleys in the roof trusses of the huge hanger. When the actual operation was undertaken it took just under five hours and there was not the slightest hitch in the procedure. Final assembly work is now continuing at full speed. The B-19 will be flown next year.

CHECKING THE FOCUS in Lockheed's new loft camera for photographing templates. Chief Photographer J. H. Washburn holds one of the 14x17 in. glass plates for the derrick-like apparatus used in a new process which is expected to save two to four months' time and $20,000 per model in plane production.

ASSISTANT PROCUREMENT OFFICER for the Air Corps, for the Detroit district, is Maj. James H. Doolittle, top-notch pilot and president of the Institue of the Aero. Sciences.



BOEING STRATO-CHAMBER—With airplanes destined to fly higher and higher, Boeing's 3-ton strato-chamber can reproduce all the conditions of high altitude flight for test purposes within the laboratory.



PART OF LYCOMING'S new vibration equipment for instrument installation testing in a Piper Cruiser. Lycoming engines of 50 to 75 horsepower are to be tested under operating conditions.

Transport Operators Meet With CAB Dec. 2 To Coesider Revision of Mail Rate Basis

Washington (AVIATION BUREAU)—During the fifteen years that the government has contracted with air carriers for the transportation of mail, several rate structures have been tried and much experience has been gained. On Dec. 2, the Civil Aeronautics Board met with representatives of the transport companies to examine possible advantages of adopting fundamentally new methods of rate making. It is hoped, of course, that whatever new structure can be arrived at will be permanent.

Agenda for discussion, as outlined by Hazlee Branch, CAB chairman, covers four points. The first point is a group of questions. Should there be a basic payment proportional to the volume of service performed? If so, should such a rate be fixed to produce compensation equal to the cost of carrying mail by air? If not, to what should the rate be related? Should the rate be uniform for all carriers or should it vary for different classes? If such a rate were not sufficient for some carriers, how should it be supplemented? On a mile basis? Should supplementary pay be figured on the need of the particular carrier?

The remaining three points are further questions with relation to supplementary pay over basic pay. Upon what basis is it appropriate to determine the amount of actual or anticipated net income that should be allowed in determining a fair and reasonable rate of compensation? Should the maximum number of schedules be taken into account in fixing compensation, and how? What basis should be adopted for determining allowances for operating expenses and for non-mail revenues? We don't know when there will be a decision.

THE IMPORTANT CENTRAL AMERICAN TRANSPORT SYSTEM OF TACA (Transportes Aereos Centro-Americanos), is now owned by American Export Airlines. TACA provides service to 243 airports in six countries and expects this year to carry 125 000 passengers as well as 5 000 000 lb. of mail and 30 000,000 lb of freight. AEA has applied to the CAB to establish service across Gulf of Mexico from New Orleans to facilitate direct connection with all countries and markets served by TACA.

AMERICA'S FASTEST twin-engined airliner—the 17-place Lockheed Ladestar which broke the transcontinental record for transports. Powered with two 1,200 hp. Wright Cyclones, the Ladestar flew from Burbank to Jacksonville in 9½ hours.

Commercial Production To Be Coetloued

Washington (AVIATION BUREAU)—The extent to which factory space urgently needed for military production shall be used for manufacture of transport airplanes is still being thrashed out inside and outside the government. But it has now been decided that some commercial production will continue. The appointment of a priorities committee on commercial planes is not, as might be assumed, the signal that restrictions are in the offing. Rather it marks administration determination that civil manufacture shall have some protection.

A month or more ago the Army was pushing for a complete embargo on production of transport airplanes. With Boeing flying fortresses standing idle at the factory waiting for engines, it could see no sense in letting the airlines have new equipment. The Defense Commission, however, took a precisely contrary view.

The dispute, reportedly, went clear up to the President. He stood with the commission, and it was decided that "a healthy air transport system is an essential adjunct to national defense." The priorities committee was then appointed, not so much to schedule orders as to stand guard against Army attrition of commercial orders.

Lightniog Oisabled Pilots

The Safety Bureau of the Civil Aeronautics Board, after long investigation, found that in the Penn Control crash at Lovettsville Aug. 31, killing 25 persons, the pilots probably were disabled by a severe lightning discharge. This conclusion was anticipated by most competent observers. There was no definite evidence of the disabling of the pilots, but the Bureau was forced to accept it as probable because all other causes within reason were eliminated.

TraosatlanticMovesSouth To Ride the Trade Wiods

Pan American Airways is taking the long way around for a surer way home. Application has been made to CAB for permission to route westbound planes returning from Portugal southward to Bolama in Portuguese Guinea, West Africa, thence westward 3,104 miles to Port of Spain in northern South America; then stop at San Juan, Puerto Rico, then a final 1,600-mile jump to New York. East bound, PAA will fly its regular route: Bermuda and Horta in the Azores. Horta will be passed up when conditions there are not favorable.

This proposed winter schedule will take effect Dec. 1 and continue till April 30, making two round trips weekly. On May 1 it is expected the new Clippers now building will have been delivered, making possible four schedules weekly.

Primary reason for the winter schedule is to assure regular trips, the need for unfailing communication with Europe, as the war spreads and intensifies, will be greater than ever. Last winter, PAA frequently encountered heavy headwinds westerly, and rough water on the Horta Harbor, causing delays. On the new South Atlantic crossing, the easterly trade winds blow so regularly that they can be counted on. They are the same winds that blew the old sailing clippers to the New World. The 3,000 mile hop calls for additional fuel tank capacity; but this same capacity serves also to pass up Horta when necessary on the eastbound run. PAA officials believe the new arrangement will enable them to haul double the number of passengers out of Lisbon this winter.

Reports were circulated that the State Department favored this South Pacific route partly in order to put Pan American closer to the Italian and German routes for competitive reasons. Maybe so. The appearance of United States aircraft on the Coast of Africa won't do any harm. State Department approval was necessary because the run south from Lisbon crosses the new combat zone at the Mediterranean entrance, declared by the President when Italy went to war.

Boston-Mexico City

Last spring American Airlines announced intention to file for a route between Dallas-Ft. Worth and Mexico City. Now comes word that the government of Mexico has granted the necessary permit to AA. The service will connect with AA's existing system at Ft. Worth and Dallas, and will stop at El Paso. This will give the company an opportunity to operate through planes from Boston, New York, Washington, all the way to the ancient capital of the Aztecs. C. R. Smith, AA president, says service will start as soon as company's application, now being filed, is approved.

Say Signals Failed

United Air Lines' accident, Nov. 4, killing five passengers and five company employees, was heartbreaking to the management and to the Authority, as well as to bereaved relatives. Up to that date United had flown 38,500,000 miles, carrying nearly half a million passengers without injury or accident. In ten years of operation with multi-motored equipment, United has flown 30,000 trips and had only four serious accidents involving fatalities.

Informed persons said that Captain Fey had normal radio signals on his approach to the airport. As he went through the routine instrument approach, the beam appears to have started discharging only "A" signals in all quadrants instead of "A" and "N". Result was that the pilot continued southeast expecting to pick up an "N" signal, and, being entirely on instruments, he crashed into the foothills of the Wasatch which rise just east of the city. AVIATION has learned that United executives believe the accident resulted from causes beyond their control.

The constructive angle on this misfortune is that investigators for the Civil Aeronautics Board, with airline officials, plan to start continuous observation of the functioning of radio range stations.

AIR TRANSPORT INDICATOR

November 1, 1940

164.4

Which is the ratio of passenger miles reported by the Air Transport Association for all domestic lines for October 1940 to the figure for October 1939. Total for the indicator has continued to fall back from the year's peak. For the first ten months of 1940 traffic stood at 883 972 082 revenue passenger miles—up 64.4 per cent over October 1939.

See Finance page for individual companies traffic figures.

Mexico Certificate

American Export Airlines, the sea-going giant that took the air to challenge the ocean-flying champion Pan American Airways, weighs in about as follows: has a certificate for a transatlantic service to Portugal, has three Sikorsky 44s in the making for the job, and is hoping for Congress to change its mind and vote money for mail pay on the run to Portugal. has possession of TACA (Transportes Aeros Centro Americanos), which covers Central America like a spider web.

From there the company hopes to go ahead by getting CAB approval of its newly-placed application for the TACA purchase, getting approval for its proposed split-route service across the Gulf from New Orleans, via many points in Central America, tieing in with TACA, to Panama City (on the border of Panama, not on the Canal). For this job Export is negotiating with Lockheed for a number of four-engined transports.

Recent Awards

War Department

United Aircraft Corp., Hartford, Conn., $458,024 for maintenance parts.

Bendix Aviation Corp., Bendix, N. J., $6,305,020 for indicators and transmitters.

Sperry Gyroscope Co., Inc., Brooklyn, N. Y., $3,494,322 for mount assembly filter.

Wright Aeronautical Corp., Paterson, N. J., $11,430,042 for aircraft engines.

Ford Motor Co., Dearborn, Mich., $122,332,020 for aircraft engines.

Square D Company, Elmhurst, N. Y., $222,000 for indicator assemblies.

Bendix Aviation Corp., South Bend, Ind., $225,628 for wheel brake assemblies.

Bendix Aviation Corp., Bendix, N. J., $287,090 for inverters.

Wright Aeronautical Corp., Paterson, N. J., $210,651 for maintenance parts for Wright Engines.

Bendix Aviation Corp., Bendix, N. J., $3,189,315 for indicator and tube assemblies.

Sperry Gyroscope Co., Brooklyn, N. Y., $8,063,240 for indicator and controller assemblies.

Goodyear Tire & Rubber Co., Akron, Ohio, $1,521,551 for wheel and brake assemblies.

Hayes Industries, Inc., Jackson, Mich., [illegible] for wheel and brake assemblies.

Bendix Aviation Corp., Bendix, N. J., $882,598 for compass assemblies.

Square D Co., Elmhurst, N. Y., $8,745,855 for altimeter assemblies.

Weston Electrical Instrument Corp., Newark, N. J., $1,509,420 for indicator assemblies.

The Glenn L. Martin Co., Baltimore, Md., $739,655 for armament equipment.

Bendix Aviation Corp., Bendix, N. J., $5,660,107 for switch assemblies.

Bendix Aviation Corp., South Bend, Ind., $12,871,320 for aircraft armament.

Standard Steel Works, Kansas City, Mo., $178,350 for standard assemblies.

Variety Aircraft Corp., Dayton, Ohio, $110,200 for standard assemblies.

Bell Aircraft Corp., Buffalo, N. Y., $220,045 for armament equipment.

Mercury Aircraft, Inc., Hammondsport, N. Y., $125,737 for trainer assemblies.

Grimes Mfg. Co., Urbana, Ohio, $230,530 for landing lamp assemblies.

Vultee Aircraft, Inc., Vultee Field, Calif., $327,782 for maintenance parts for planes.

United Aircraft Corp., East Hartford, Conn., $632,430 for maintenance parts for planes.

Jack Heintz Ltd., Palo Alto, Calif., $2,535,867 for starter assemblies.

Lycoming Division, Aviation Mfg. Co., Williamsport, Pa., $6,705,030 for airplane engines.

General Electric Co., Schenectady, N. Y., $1,138,170 for generator and regulator assemblies.

Electric Storage Battery Co., Philadelphia, Pa., $552,824 for aircraft storage batteries.

Goodyear Tire & Rubber Co., Akron, Ohio, $2,856,517 for wheel assemblies.

Hayes Industries, Inc., Jackson, Mich., $812,028 for wheel assemblies.

Navy Department

Consolidated Aircraft Corp., San Diego, Calif., $73,313 for airplanes.

Glenn L. Martin Co., Baltimore, Md., $100,105 for airplanes.

United Aircraft Corp., East Hartford, Conn., $58,400,703 for airplane engines.

By Raymond Hoadley

Both the aircraft manufacturing companies and the domestic air transport lines as a rule, will report record breaking earning power in 1940, despite substantially higher taxation. Meanwhile a new aircraft procurement program is taking form in Washington that bids fair to nearly equal the huge 1940 program now under order. The new program may entail 12,000 planes for the British, 20,000 for the U.S. Army Air Corps and possibly another 5,000 for the U.S. Navy. New armament programs, more plant expansion, labor problems and the entry of the motor car makers—all present a fast-moving and ever-changing picture as Uncle Sam begins building a powerful air defense. The aircraft companies have no difficulty securing necessary working capital these days.

Industry Backlog

Unfilled orders of the aircraft industry now approximate $3,500,000,000, an increase of $385,000,000 in the past month consisting mainly of U.S. Navy orders. Only a year ago the industry was expanding its plant capacity to take care of a backlog which had crossed the $500,000,000 mark for the first time. Now that the U.S. Government's current aircraft purchasing program is nearly completed, plans already are being formulated in Washington for a new 20,000 military plane program to be presented to Congress early next year. Meanwhile Great Britain plans to order an additional 12,000 planes and the Dutch East Indies, among other nations, also are shopping around for more war planes. Contracts held by domestic plants come to a grand total of about 36,000 fighting craft, 25,000 for the American military and naval forces, and 14,000 for the British. The following table gives the latest approximate unfilled orders in dollar volume of 23 primary producers of planes or aircraft engines.

Allison (General Motors)	$100,000,000
Aviation Corp.	20,000,000
Beech	22,000,000
Bell	60,000,000
Boeing	203,000,000
Brewster	100,000,000
Cessna	11,000,000
Consolidated	300,000,000
Continental Motors	25,000,000
Curtiss Wright	520,000,000
Douglas	400,000,000
Fairchild	15,000,000
Ford	122,000,000
Grumman	80,000,000
Lockheed	211,000,000
Martin	322,000,000
North American	225,000,000
Northrop	24,000,000
Packard	217,000,000
Republic	85,000,000
Ryan	12,000,000
United Aircraft	400,000,000
Vultee	95,000,000
	$3,532,000,000

Deliveries of the primary aircraft companies are now running in the neighborhood of $60,000,000 a month. But while output has more than doubled in the past twelve months it is still far short of the goal that must be attained to meet the needs of the defense program and the British. Plane deliveries in the first nine months amounted to about $400,000,000 and it now appears likely that the total for the full year will be around $800,000,000 as against $225,000,000 in 1939. The industry will not hit its stride until the summer of 1941.

The following table gives a preliminary estimate (in millions) of the 1940 sales of a group of six of the large aircraft manufacturers, together with the 1939 comparative figures. In each case sharp gains in dollar volume are shown this year.

	1940	1939
Boeing	$20	$12
Curtiss-Wright	122	46
Douglas	80	[illegible]
Lockheed	42	[illegible]
North American	38	28
United	112	48
	$354	$200

Several of the domestic airlines established new monthly records during October, reversing the normal trend at this season of the year. As a result several of the lines are planning to continue flight schedules throughout the winter season on an equal level with those maintained during the summer. Most of the major companies now have shown over the corresponding months of the preceding year an increase in passengers carried and revenue-passenger-miles for a period of 24 to 26 consecutive months.

Banking circles report that Boston Maine Airways, Inc. is contemplating an offering of common stock to be handled through a syndicate of Boston and New York financial houses. It is planned to raise around $600,000 through the financing. Two other lines, American Airlines and Penn-Central Airlines, recently sold stock to finance the purchase of new equipment. American brought out an issue of 50,000, 4½ percent preferred stock at $70 a share while PCA sold 60,000 common shares at $15.87½ a share.

TWA has chosen another means of financing its new equipment program, having arranged a four-year revolving credit with a group of banks. Under the agreement TWA is permitted to borrow $2,500,000 initially and varying other sums graduated downward annually to the agreement's expiration in 1944. TWA officials favor this form of financing because it "provides extreme flexibility and assures the airline of adequate funds without the necessity of fixed borrowings."

Activity in aircraft plant construction has become a big factor in operations of the structural steel companies. Bethlehem Steel Co. has a contract from Curtiss-Wright for 9,500 tons of steel and one from Republic Aviation requiring 8,000 tons. U.S. Steel Co. secured a Curtiss-Wright order for 6,000 tons, while Curtiss-Wright and Boeing gave orders totaling 10,000 tons and 3,000 tons respectively to unnamed steel makers. In addition, Curtiss-Wright is making inquiry in the market for 16,500 tons of additional steel for plants in Ohio and Missouri.

Howard Hughes, through Hughes Tool Co., purchased an additional 13,700 shares of TWA in September, according to the latest report of the SEC on security purchases and sales. The Hughes holdings in TWA now total 365,650 shares or more than 40 percent of the airline's capital stock.

Current Earnings Reports

Company	Period	Net Profits 1940	Net Profits 1939	Profits per share 1940	Profits per share 1939
Aviation Corp.	9 mos. Aug. 31	$72,855	d $1,324,047	$0.02	
Borg Warner	9 mos. Sept. 30	4,125,231	3,484,036	1.75	$1.40
Continental Motors	9 mos. July 31	389,138	d 144,809	0.13	
Curtiss-Wright	6 mos. Sept. 30	8,305,639	4,543,552	0.88	0.38
Douglas	6 mos. Aug. 31	7,288,335	2,382,159	12.15	3.97
Ex-Cell-O	6 mos. Sept. 30	1,337,727	530,514	3.49	1.34
Fairchild Av.	6 mos. Sept. 30	422,031	295,512	1.25	0.87
G. L. Martin	9 mos. Sept. 30	4,814,984	1,513,778	4.40	1.39
North American	6 mos. Sept. 30	3,338,538	5,049,617	0.97	1.47
Square D	6 mos. Sept. 30	1,263,002		2.82	
Thompson Products	6 mos. Sept. 30	560,802	292,618	1.78	0.89
T W A	6 mos. Sept. 30	237,187	d 5,489	0.25	
United Aircraft	9 mos. Sept. 30	6,199,763	5,799,307	3.46	2.18
United Airlines	6 mos. Sept. 30	1,017,422	354,367	0.68	0.23

d — deficit.

With the Airlines

Company	Revenue Passenger Miles* October 1940	October 1939	% gain	10 Months 1940	10 Months 1939	% gain	Revenue Passengers October 1940	October 1939	% gain	10 Months 1940	10 Months 1939	% gain
American	35,398	22,336	59	263,606	166,653	51	104,158	59,128	76	735,858	435,634	68
Chgo. Southern	2,117	936	102	13,584	7,402	83	5,466	2,401	137	35,611	18,762	90
Eastern	14,794	9,114	63	129,993	82,196	58	37,000	23,756	64	284,874	196,352	45
Northwest	5,396	8,728	51	45,138	28,782	60	12,311	3,558	65	98,424	60,929	61
Penn-Central	4,285	2,073	106	32,318	17,496	84	24,616	12,093	103	181,994	100,960	80
T W A							ƒ35,991	21,055	71	x 240,235	130,411	72
United	25,201	15,800	60	166,184	124,802	57	ƒ46,888	31,746	36	x 343,821	208,091	65
Western Air	1,695	923	45	13,651	9,146	51	ƒ5,081	3,135	62	x 38,167	22,130	63

* (000 omitted)—ƒ Sept.—x 9 months

Douglas Aircraft is creating business for automotive and industrial concerns east of the Rocky Mountains through the placing of subcontracts totaling in excess of $75,000,000 for parts and subassemblies. Briggs Mfg. Co., General Motors Corp., Murray Corp., all of Detroit, Fleetwings Co. of Bristol, Pa., Goodyear Aircraft Co. of Akron, McDonnell Aircraft Co. of Robertson, Mo., and Aircraft Mechanics, Inc., of Colorado Springs are sharing in the orders. Large contracts also are slated for such West Coast companies as Solar Aircraft, Hammond Aircraft, Axelson Mfg. Co., Hammond Aircraft Products, and Vega Airplane Co.

Dividend season has arrived for aircraft investors. Unlike most industries, few aviation companies pay quarterly dividends. A few, including the Sperry Corp. and United Aircraft Corp., usually declare dividends in June and December but the majority who pay dividends make only one disbursement at the year-end. This month Curtiss-Wright will pay a common dividend of 50c. a share—the first common dividend declared since the present company was organized in 1929. Douglas Aircraft led the dividend paying procession this fall, declaring a dividend of $5 a share, payable Nov. 20, as compared with one of $3 a share a year ago. United Aircraft followed with a $2 dividend, payable Dec. 16, bringing payments for the year to $3.50, as against $2 in 1939.

Other security transactions by directors of aircraft companies included the following: Leclanche Moen sold 1,100 shares of Aara Supply Mfg., L. B. Manning sold 1,000 shares of Aviation & Transportation Co. common stock while Gene Tunney bought 1,000 shares. H. E. Ryker bought 500 shares of Aircraft Accessories class A stock. E. R. Palmer sold 500 shares of Bendix Aviation, and James Work sold 400 shares of Brewster Aeronautical Corp. At the same time Lewis Kalb and Clarence Reese bought 1,250 and 1,000 shares, respectively, of Continental Motors. Edmund T. Price bought 700 shares of Solar Aircraft Co.

National Aviation Corp., a leading aviation investment trust, reports indicated net assets on Sept. 30, 1940, were equal to $16.93 a capital share, as against $16.48 a share on Sept. 30, 1939. Frank F. Russell, president of National Aviation, has been elected a director of the Bank of Manhattan Co.

Much of the boom one hears about in the machine tool industry stems from the aviation companies. For example, Ex-Cell-O Corp. has under way a $3,000,000 expansion program to increase facilities for handling its rapidly increasing aircraft parts business. The program is to be financed through term bank loans and will increase manufacturing capacity about 50 percent.

Earnings of the nation's air transport industry in September were approximately double the income earned by the airlines in the same month of 1939, according to nearly completed reports of individual companies filed with the Civil Aeronautics Board. With reports lacking from only two of the major companies, the combined net income, before taxes, was about $1,400,000 for the reporting operators, comparing with around $725,000 in September 1939. Chicago & Southern and Mid-Continent were the only two reporting deficits while TWA, followed by American Airlines, reported the largest earnings for the month.

Here and There . . . The million dollar expansion program at Northrop Aircraft's Hawthorne, Calif., plant will not require additional financing or borrowed capital as the company has ample funds for the project . . . Waco Aircraft production has reached a new peak of 21 planes a week . . . Backlog of Kinner Motors stands at $700,000, an increase of $150,000 since early in September . . . Bell Aircraft and Beech Aircraft are furnishing the funds for their respective plant expansions but the government will repay them for these expenditures over a five-year period . . . Piper Aircraft produced over 2,000 planes in the first nine months of 1940 and expects to pass the 3,000 mark before the year closes . . . Fairchild Aviation Corp. has unfilled orders currently totaling around $5,200,000, up from $1,988,000 a year ago. Shipments of Boeing Airplane Co. were $6,032,000 in the quarter ended Sept. 30, as compared with $7,567,000 in the preceding six months . . . Budd Mfg. Co. has licensed Piper and Solar to use the Shotwell Process—which takes the place of riveting—and other companies including North American, Martin and Boeing are reported negotiating with Budd for its use. Profit of Curtiss-Wright Corp. for the first nine months this year was at an all-time high record.

Plane Financing

The First National Trust & Savings Bank of San Diego is receiving the blessings of the entire private flying industry these days because of an advertising campaign it has sponsored. The copy reads, "The First National will help you to buy your own plane. Here in San Diego the air capital of the west, we have watched the rapid and sound growth of aviation. Month by month records have shown more hours flown, more mail and express carried, and more passengers delivered safely. . . . Each happy landing has increased the number of boosters for this modern method of transportation, and has created a desire among many to own a plane of their own. You are invited to discuss an airplane loan with any officer of the First National at the main office or any branch."

Members of the Kansas City Junior Chamber of Commerce have become so air-minded since the organization began sponsoring the CAB's non-college flight training program that plans have been announced whereby twenty of the members will form a corporation to purchase a plane and learn to fly. The planes will be delivered Nov. 15. Each member of the corporation hopes to obtain his pilot's license within three months. Chairman of the U. S. Junior Chamber of Commerce is Edward A. Tappe of Kansas City, who holds a commercial license.

Athens Activities

Typical of activities going on in many parts of the country are those of Athens, Ohio. Within a year five Taylorcrafts, two Wacos and a Beechcraft have been purchased and two new hangars have been built. Under the direction of Gardan K. Bush, head of Athens Airways, 30 CPTP students are in the primary training group and ten more are in advanced training. Numerous students are paying for their own flying time.

Hibbing Airport

Up in northern Minnesota the town of Hibbing is getting itself a fine new flying field. Some $200,000 was spent on the field and now $50,000 more is being used for a new hangar. Under Millar Wittig's direction, CPTP activities are going on at full speed and the field is one of the most active in that area.

Seaplane Base

Twelve miles from the Canadian border at Ely, Minn., is the largest seaplane base on inland waters in the country, so we hear. Ely is in the midst of hundreds of inland lakes and seaplanes have proven to be the best means of transportation to many of the outlying sections. It is the headquarters for the U. S. Forestry Service which maintains a seaplane forest fire patrol. Seaplane service has greatly reduced the fire hazard in the northern woods in recent years.

In addition to a great amount of student work, Bill Leithold has had considerable success in flying fishermen to lakes which are inaccessible by auto roads. Fishing parties can fish directly from the seaplanes. Leithold regularly hauls hay for a horse located at the Curtain Falls Fishing Camp, has transported a dismantled saw mill, automobile engines and many bundles of camping equipment. Both the Forestry Service and private owners are building new hangars at Ely.

Graham Aviation flight school at Butler, Pa., is now operating out of Oil City, Meadville, Waynesburg, Meyers Field (Bridgeville, Pa.), Allegheny County Airport and Americus, Georgia—also maintaining a seaplane base at the Point in Pittsburgh. That sounds like expansion, added to the fact that Bill Graham in the past few months has increased his flight-plane fleet by a Stinson 105, a Fairchild, five Piper Cub Trainers, and two Waco YPT14 Army trainers, for the CPT program.

New Hangar, Airport For Montreal

At Montreal work has begun on the construction of a new hangar—the largest ever erected in Canada as one unit—for Trans-Canada Air Lines at Dorval, near Montreal. Runways are being laid out and the government is building an administration building. Dorval will replace St. Hubert Airport, which will be devoted to war purposes. It is expected the new TCA hangar will be ready for occupancy next July.

One of New Orleans' early airports, almost beginning to fade from public memory leaped again into the spotlight with that city's plans for national defense when the local superintendent of municipal airports in New Orleans announced that an application for $2,729,500 had been placed with the national administrator of CAB.

The proposed improvements include the purchase of additional adjacent land totaling 580 acres, which added to the present airport of 146 acres will give an enlarged airport of 725 acres. $58,000, de-stumping and grading newly acquired land, $70,000, replacing present turf runways with concrete runways and constructing new concrete runways on enlarged airport, $1,700,000, building taxiways, roadways and aprons, $500,000.

Planning for the Sportsman's Show, at Grand Central Palace, New York area: l. to r., Al Bennett; O. P. Hebert of Safair; and Charles Strong, Campbell Fairbanks. Big plans are being made for the show and light-plane salesmen and manufacturers are looking forward to a successful exhibition.

TRAINING

Republic's Training Plan

Entering on one of the industry's most ambitious training programs, Republic Aviation Corp. has begun training the first of some 8,000 men for its expanded plant at Farmingdale, N. Y. Desiring to secure men who live in the vicinity of the plant, the corporation set up an employment committee of plant officials who have gone to all nearby towns to interview applicants. Men who meet the standards are accepted for training and sent to the Faust Aircraft Sheetmetal School at Jericho, Long Island, where they are given courses running from one to three months. All training expenses are met by Republic.

The Faust School will soon have 2,000 students, studying on a two-shift basis. Republic will receive approximately 250 trained men per week once the graduates start leaving the school.

State Schools for New York

Aircraft factories within New York State contemplate they will need some 52,000 men in the near future, according to a survey made by Oakley Furney of the State Education Department. This great expansion is far beyond the facilities of present public and private schools. Public funds have been voted for the establishment of about thirteen schools located throughout the state which will concentrate on short-term courses in practical work that will prepare them for jobs.

Schools will be located in the following centers: Long Island, New York City, Yonkers, Utica, Plattsburgh, Elmira, Watertown, Syracuse and Olean. Courses will start in some centers this month, and will be organized to fill industry needs.

Lincoln School Grows

Due to increased enrollments in its civilian mechanics school and the opening of an Air Corps Technical Training School, the Lincoln Aeronautical Institute of Lincoln, Neb., is now completing an improvement and equipment project to provide for a $200,000 expansion program.

The new improvements will provide approximately 50,000 sq.ft of additional floor space which will be devoted to new classrooms, new laboratories and shops for practical training.

Among the several new features in its modernization project, is the installation of an air-conditioning system and fluorescent lighting which supplies "daylight" conditions in shops and laboratories.

Rapid expansion of the government training program has necessitated the addition of eighteen instructors by the Sweeney Aviation Schools, Inc., Fairfax Airport, Kansas City, Kan.

Director of Education is Julien Q. Myers, with a commercial Class 1 and 2S lend-rerated flight instructor and ground school instructor rating. Mr. Myers organized and directed the aircraft school at Oklahoma Military Academy, and later served for six years as chief flight and ground school instructor for Spartan Aircraft.

A novel angle on the recent draft registration was established in Glendale, Calif., of a special precinct at Curtiss-Wright Technical Institute for registration of students under O. D. McKenzie, Registrar of the school. A staff of fifteen girls was employed to handle clerical work and out of the 1,200 civilian students 532 men were found old enough to register. This represented a lead of 323 registration cards over any other precinct in the entire city of Glendale.

With 230 students of aeronautical engineering and aviation mechanics courses enrolled in a 30-day period, Curtiss-Wright has reached a new record enrollment figure of more than 1,200 civilian students in addition to nearly 1,000 Army Air Corps enlisted men in training.

Seventy-five civilian pilots who hold at least a commercial pilot rating have been given 25-hour instruction courses at Cal-Aero Academy, Ontario, Calif., preparatory to becoming primary instructors of Army Air Corps Flying Cadets at Cal-Aero's schools in Glendale, Oxnard, and Ontario. This marks a departure in instructor training since such standardization courses were hitherto given only at Randolph Field.

The Cal-Aero field at Ontario was opened to the public on Sunday, Nov. 10, for a breakfast meeting of 75 lightplane pilots arranged under the supervision of the Los Angeles Junior Chamber of Commerce.

Armistice Day was made the occasion in California for dedication of the new Ryan Air Corps primary training center at Hemet. This school operates as a branch of the main Ryan school in San Diego. Seventy cadets are entering the school every five weeks for the ten-week primary training period. The $250,000 Ryan training base was completed and placed in operation just 37 days after ground was broken. The new school provides barracks, mess hall, lounges, administration buildings, classrooms, laboratories, overhaul shops and hangars.

New Wichita School

To help supply aircraft workers for the expanding plants in Wichita, E. S. Taxmen has opened the Aero Technical Institute. The school is affiliated with the Aero Parts Mfg. Co. Courses are offered in sheetmetal work, welding, blueprint reading and drafting.

"Air University"

Miami has an "air university." The Embry-Riddle School of Aviation, which handles most of the government flight training in the area, is starting a ground school to handle 1,500 aircraft technical students. Headquarters is the boom time "Fritz Hotel", which Riddle has leased and is renovating. About $100,000 worth of aircraft technical equipment is being installed. First students, to be received in groups of 500, start work in early December. The school is cooperating with Army, Navy, Pan American, and Eastern Airlines. Thomas E. Halpin, Army flyer and aircraft manufacturer, is supervisor.

As a contribution to national defense training, Aero Industries Technical Institute is now offering training in armament design as part of its aeronautical engineering curriculum. According to James L. McKinley, managing director of the school, Aero ITI is the first civilian aviation school in this country to offer training in armament design. This portion of the engineering course involves study of aircraft armaments and the actual design and engineering of weapons. In addition to inside laboratory facilities, a full sized outdoor firing range has been constructed on the Aero ITI campus. Instruction in armament is under Harvey G. Chapman, Jr., armament engineer formerly with Boeing, Douglas, Lockheed, and the Svenska airplane works in Sweden. In addition to this specialized instruction Aero ITI is carrying on specialized research and development work on armament design.

Wallace-Martin Aircraft Corp. is at present working on a new experimental fighter for which it has a contract with the Navy. Wallace-Martin, headed by Alastair B. Martin, president; Esmond B. Martin, vice president, and Richard R. Vineyard general manager, began work in their Long Island City plant in July.

Vail Field, Los Angeles, once the home port of Western Air Express, has been re-opened under the direction of the United Flying Schools of America, Inc. New runways, taxi strip and hangar have been constructed on the 400 acre field. Complete hangar, service and repair facilities are being offered to private fliers by the United Flying Schools. Its opening will serve to relieve the congestion which has been growing acute at airports throughout Los Angeles County. Officers of the United Flying Schools include Ralph Hemphill, president, Rene Olin, Jack West, and Bertrand Rhine.

In Pittsburgh

A new drafting and sheet-metal school has opened called the Aero Tech of Pittsburgh. The school is affiliated with Aero Technical Industries, builders of airplane starters, jacks, armament and aerial towing devices. Vice president and general manager is R. V. Trader, veteran pilot who was an engineer with Curtiss in the last war, and later with Martin.

Correction

In the November issue of AVIATION we mentioned, in error, the Aeronautical Institute of Technology, when we should have said Aero Industries Technical Institute. The paragraph, which appeared on page 112 of the November issue, should have read: Also near the Grand Central Air Terminal, but located within the city of Los Angeles, is the Aero Industries Technical Institute, which specializes in aircraft production engineering and production methods. This school has close connections with a number of large manufacturers and has grown rapidly, now having an enrollment in the neighborhood of 1,000 students.

Plastics Institute

Formed largely as a result of the rapidly increasing use of plastics in aircraft construction, the Plastics Industries Technical Institute has been organized in Los Angeles for the purpose of instructing engineers in the use of plastics and also to conduct research with plastics. John Delmonte, well known research engineer, is technical director of the new plastics school. Speaking before a group of aircraft engineers recently Delmonte pointed to the advantages to be gained by using plastics for parts with unusual shapes and curvatures, for housings, ducts, electrical conduit, pilot's seats, large external fillets, ammunition conveyors and empty cartridge chutes, gun turret housings, cockpit enclosures, etc. Germany and England both are making intensive use of plastics, it is reported, in the form of sheets, tubes, rods, and extrusions.

Major exposure of the Curtiss-Wright Technical Institute of Aeronautics, Glendale, is announced by Major C. C. Moseley, president. New shop buildings totaling 24,000 sq.ft, are under erection at a cost of $50,000 for the use of civilian mechanic students, and eight new buildings costing $100,000 are being provided for training the Army personnel. With 230 civilian students enrolled during the past 30 days, the civilian enrollment now exceeds 1,200 students, in addition to a contract to train 1,053 Army enlisted men as aviation mechanics. Announcement of the above construction program marks the fourth major construction project at Curtiss-Wright Tech during the past twelve months.

New Trainers for Parks

Parks Air College has ordered four new Stearman trainers and expects delivery early next month. These are the first ships of this type to be sold for commercial use, the others having gone to the Army and Navy. This brings the air fleet at Parks to 22 ships devoted to commercial training.

Coming in FEBRUARY

"ALL AMERICAN AIR SHOW IN PRINT"

Aviation's 8th Annual Directory Issue

. . . the principal and most authoritative source of information on the aviation industry published. Its great reference value makes it widely used by all branches of the industry. The 1941 edition will be greatly expanded to include new data now vital to the industry's need for more complete buying information. Aviation's editors have already been at work for months, have flown thousands of miles gathering the mass of basic material necessary to prepare this biggest and most comprehensive Annual Directory Issue of the Series. Here's a quick picture of the valuable and useable material which will be included in the feature sections.

IMPORTANT TO ADVERTISERS—**Print Order over 65,000** giving thorough coverage of aircraft manufacturers, engine and parts manufacturers (including sub-contractors), operators, government and military officials, aircraft owners, dealers and distributors. **Price 50c per copy on the newsstands** ☞ **Place now to advertise your products** in the 1941 Edition of Aviation's 8th Annual Directory Issue—published in February

1

Complete description and performance details of America's civil, transport and military aircraft . . . illustrated by photos and 3-view drawings.

BIGGER THAN EVER BEFORE, this "catalog of aircraft" section will be profusely illustrated with drawings of all the airplanes that are available *and* actually in production—at the time the February issue goes to press. Standard and special equipment as well as the instruments used on each plane will be listed. Other valuable facts and figures will include engine installations, performance data, dimensions, weights. In addition, there will be a useful portrayal of design details of each latest type of American plane.

2

Comprehensive collection of detailed specifications of all American aircraft and engines (excluding only military models on restricted list).

THIS FAMED and popular section is the joy of engineers. Not only because it gives dimensions, weights, prices and construction features but remember that these important pages are easily detachable. Additional reference value is yours because you can slip these pages under the glass top of your desk or table or mount them on the wall nearby. This complete and unabridged collection of specifications makes it easy for you to check each model for quick comparison.

3

Complete section of design detail drawings. Design trends will be graphically illustrated. Also latest types of engines—actually installed.

AVIATION'S *outstanding* "SKETCH BOOK of DESIGN DETAIL" section will be expanded and include perspective sketches illustrating the principal features and technical advances in the new models (as described in Feature Section No. 1). This is really the "design trend" section of the Directory Issue—here you will see the latest in what's new and available at the moment. Another valuable part of this section provides you with pictures *and* drawings showing the most recent types of engines—actually installed.

4

For quick reference—a complete directory of aircraft, engines, accessories, parts and equipment manufacturers—and chief personnel . . .

Plus

the invaluable storehouse of information for study and comparison given in the four feature sections, there will also be facts and figures on the industry showing the increase in the number of pilots and planes, manufacturing statistics and other new data.

You'll find use for this directory throughout the year. It's a year round handbook which you'll want to keep within easy reach. Besides being a complete exhibit of American aircraft, it is a buying guide simplified by products, by company names and important personnel. It will be more valuable than ever before. For complete buying information of who makes it, who sells it, where to buy it—and who's who in the aviation industry—be sure to send in your reservation now. Price 50c per copy.

HERE'S YOUR "ANSWER BOOK" section for such daily questions that come up—such as, "Who makes it?" . . "Who sells it?" . . "Where can we buy it?" or "Who's who in the industry? All of this wealth of vital information will be assembled in easiest-to-locate form. Alphabetically arranged, complete, up-to-the-minute, you will quickly see how this section will save you plenty of time and effort when you need essential buying information.

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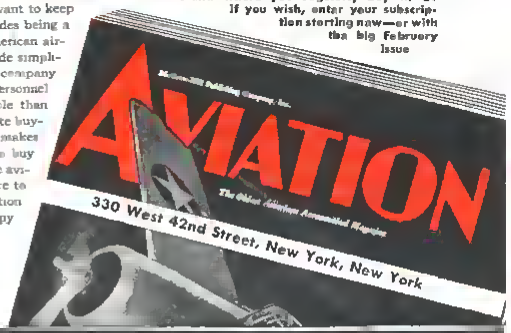


ALL IN ONE BIG COLORFUL ISSUE: Vital Engineering & Buying Data ✰ Latest Designs ✰ Sketches & 3-View Drawings ✰ Industry Facts, Figures & Personnel

Private Owner

(Continued from page 53)

have warmed up and the oil temperature has started to rise. This rising temperature means that all the oil has been through the engine and is therefore warmed up sufficiently for lubrication. Then as soon as the engine will take acceleration, get it in the air, and after the field obstacles are cleared then reduce the climb and increase the air speed to a point where adequate cooling will be effected. The penalty for too much ground running may possibly be stuck rings or scored cylinders.

The stopping of an engine is as important for its longevity as is the starting. Most engines are now equipped with a needle-valve type mixture control that will completely stop the flow of fuel from the carburetor, so that it has become good practice to run the engine at a moderate speed until the head temperatures have dropped, at least to below 300 deg., and then pull the mixture control all the way out, at the same time opening the throttle. By pulling the mixture control all the way out, the fuel is completely cut off so that back-firing or detonation cannot take place. The opening of the throttle is desirable so that the residue of gas left in the discharge nozzles will not be carried on up under the considerable suction that is present with a closed throttle, allowing the engine to operate, even for a brief time, on an extremely lean mixture. When the throttle is open, the high suction is not present, as air is free to enter the induction system. This method is not applicable to some of the older engines using a different type mixture control, but it is applicable to a majority of the later power plants.

Several periodic inspections are made. Some operators differ on the exact time, but in general it is good practice to make these periods at about 25, 50, and 100 hours. The 25-hour inspection, on non-scheduled aircraft at least, usually is the time for oil change and engine checks on those engines which do not have automatic overhead lubrication.

When the oil is changed, the sump screens should be removed and observed for any deposit of foreign materials. The presence of metal particles would indicate immediately that malfunctioning was present within the engine. In case there is no such deposit, the screen should be cleaned and replaced in the engine, care being taken to see that it is safetied. If the engine does not have overhead lubrication it should be checked at this time by a competent mechanic. Many of the newer small engines can be checked by the pilot or owner at this period. I am speaking of those types which do not require setting of valve clearances. Nor should it be necessary at this time to go into the magneto breakers, but it will usually only be necessary to clean the strainers, both oil and fuel, see that all connections are tight, run the engine to see that spark plugs are operating satisfactorily, and to check the propeller for tightness and for alignment, and that the motor mount bolts are tight.

The aircraft should be checked over, hinge pins oiled, and inspection plates giving access to the more important controls should be opened and these parts inspected. Controllable props should be lubricated at this time. On many of the later types it is not necessary to grease the spider more often than each 50 hours. However, it is very important that the counter weights be greased at this time or at more frequent periods if they are observed to be dry. The lubricants in most general use for this purpose are Mobile Grease No. 2 for the barrel and either Mobile Grease No. 2 for winter, No. 3 for summer, or Lubriplate. One precaution to be observed is to see that these two lubricants are not mixed. This can be ascertained by the color, as the Lubriplate is a white or cream colored, heavy grease, while the Mobile Grease is amber.

Since this is the time for oil change, it is apropos to mention what I think is a very important item. There are a large number of good oils, any of which will do a good job of lubricating, but it has been generally recognized that because of manufacturing processes, it is advisable not to mix brands if it can be prevented. There have been examples of undesirable chemical reactions between two oils that by themselves were perfectly satisfactory. This same rule should apply to all of the lubricants used.

At the 50-hour periodic inspection all of the items that are usually performed at 25 hours should be done, and at this time those engines using overhead lubrication should be checked. Some manufacturers of power plants say that a check is not necessary oftener than 100 hours, but I believe that experience substantiates the desirability of a more frequent check. This engine check in all cases, even on the smaller engines, should be made by a competent mechanic as it is desirable to test the spark plugs, inspect breaker assemblies, check compression, and the other items attendant on a thorough inspection. As to the airplane, the usual 25-hour inspection will cover, as it has been found that if all the work necessary on a 100-hour inspection be performed, that it is unlikely that any structural troubles will be encountered.

Speaking of spark plugs, many instances of ignition trouble in between checks would not occur if the plugs were properly tested and set at a periodic inspection. We have found in practice that the only reliable test is using CO-2 gas, and magneto ignition. If this is at all available it should be taken advantage of. We test plugs at 180 lb., having found long ago that the old recommended pressure of 120 lb. did not give reliable results. However, if a plug will test at 180 lb., we find that it will usually run through to the next check with no trouble, as this is a more severe test than its actual operating condition.

100-Hour Inspection

At this inspection all of the work done at the previous inspection periods is also accomplished, and in addition a very complete inspection should be made of the engine, airplane, and all components. Late flight reports should be studied and all troubles noted there should be corrected. The engine should be checked, the oil changed, and a critical inspection should be made of every item, including controls, bonding and shielding. Motor mounts should be examined carefully. All plumbing lines, particularly where they pass through brackets or other fastenings should be inspected to see that vibration has not caused wear. The propeller should be removed and examined for any undue wear on splines or taper, and on controllable pitch propellers the counter weights should be washed out and regreased. In the case of Lycoming Smith propellers the back plates should be removed and the old grease cleaned out so that gears can be inspected and packed again with fresh grease.

On the airplane all the inspection plates should be removed so that all controls, fittings and other units may be minutely inspected. Control cables should be very carefully checked where they run over pulleys or through fairleads. If they are frayed at any point they should be replaced. The freedom of action of all pulleys should be checked. Attachment point of cables to horns or other fastenings should be examined for elongated holes. Wing root fairings should be removed in order to closely examine wing attachment bolts, particularly to see that no elongation of the hole has occurred, or, in the case of wood spars, that no grain checks or cracks are present. Drag and anti-drag wires, if present, should be checked, and if necessary, tightened. If any of these should be found unusually loose the cause should be ascertained. Wooden spars at the point of compression struts and inter-plane bracing should be carefully checked. The covering should be checked for wrinkling or looseness at any particular point and if present the cause must be

(Turn to page 138)

6 Round Trips To the Moon!

MARTIN CLIPPERS ROUND OUT FIVE YEARS TRANS-PACIFIC...

FIVE YEARS SHUTTLING back and forth across the biggest ocean of them all—the 8,500-mile Pacific! That is today's record of Martin's famed "China" and "Philippine" Clippers. Few, if any, airplanes ever built have equalled the gruelling service of these Pan-American Airways ocean airliners —10,000 hours flight time between California and the Orient for each of them. Or, more strikingly expressed, each of these airplanes has spent nearly one quarter of the past five years in the air—actually 23.9% of the actual hours since November 22, 1935.

AND TODAY these airplanes are as sturdy as ever, still first ships of the line, taking their regular scheduled turns over the Pacific route! They have traveled almost 3,000,000 route miles, carried nearly 4,000 passengers with heavy loads of mail and express, and every week the amazing record increases—with no end in sight.

THESE "SHIPS that couldn't be built," piloted by the late famed Captain Edwin Musick, soared westward from San Francisco on the first scheduled trans-oceanic air service on November 22, 1935. Today, men and women and children casually step aboard these first air leviathans and are whisked across the vast ocean in luxurious comfort and in a fraction of the time of surface vessels.

THE GLENN L. MARTIN COMPANY pays tribute to Pan-American Airways and its skilled personnel for the magnificent record of operation. And MARTIN takes justifiable pride in having conceived, engineered and constructed these modern ocean airliners—worthy contributors to the advancement of peaceful air commerce.

TODAY MARTIN PRODUCTION is devoted to defense. But when peace again rules this world, MARTIN will send forth greater and faster airliners to increase world commerce under the Stars and Stripes.

THE GLENN L. MARTIN COMPANY, BALTIMORE, MARYLAND U. S. A.

MARTIN AIRCRAFT HELD THE FIRST OVER-OCEAN FLIGHT RECORD for a [illegible] 1935 Glenn L. Martin [illegible] Island [illegible] Pacific record for [illegible]

Record

NUMBER OF TRIPS	361	PASSENGERS CARRIED	3,973
ROUTE MILES FLOWN	2,994,717	MAIL TON MILES	568,720
PASSENGER MILES	12,718,213	EXPRESS TON MILES	274,735

MARTIN

BUILDERS OF DEPENDABLE AIRCRAFT SINCE 1909

4 Engine Maintenance

(Continued from page 45)

Over 100 ¾-inch tubes were inserted in the supercharger duct where the new duct intersected. The tubes were sealed together at each end so the compressed air could pass only through the tubes. The air, entering through the new intake, circulates through these tubes and cools the compressed air before exhausting through electrically operated shut-off valves located in the exhaust duct in the underside of the wings. The flight engineer, who is in charge of the supercharging system, can control this valve and can close it in cold weather, thereby relieving the load on the steam heating system by allowing the compressed air to retain its heat.

The instrument department maintains the condition of the supercharging system and overhaul experts are assigned to inspection work to insure cabin door and hatch seals are in perfect condition at all times, otherwise it would be difficult to maintain a steady cabin pressure.

It is interesting to note that a few passengers making their first trips on the Stratoliner have informed the air hostess that the "altitude conditioning system bothered them, when the system had not yet been turned on, and, on the other hand, the same passengers did not notice when the system actually began to work. The supercharging system is one of the prides of TWA, first to introduce high altitude flying on domestic airlines.

The Stratoliner's engines are equipped with two speed supercharger blowers, which also makes necessary a different system of engine service overhaul compared to the Douglas planes.

Some of the Stratoliner's control surfaces are fitted with hydraulic booster units to aid the pilots' manual operation and these are so balanced that overcontrol is impossible.

In general, various maintenance operations on the Boeings are practically the same compared to the Douglases, but the Stratoliners have many more items to be checked, and, as a result, more maintenance man hours are necessary.

Today, TWA's maintenance program again is operating in routine fashion for both Douglas planes and Boeing Stratoliners. With the preliminary program completed and overhaul work running smoothly, it is a question only of added manpower to handle the new duties required for the country's largest land transport planes.

Navy Maintenance

(Continued from page 39)

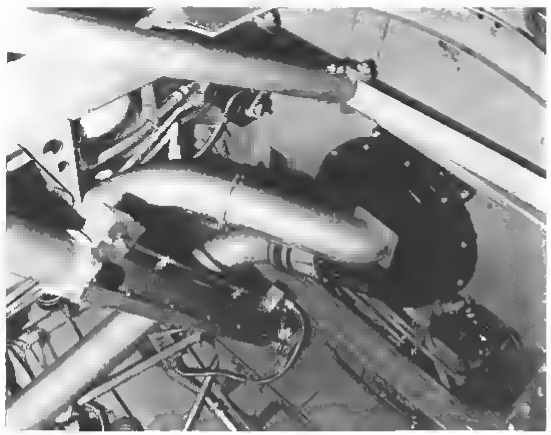
past year, and construction is still in progress. Commanded by Capt. J. S. McCain, this is the Navy's largest maintenance base. A & R (Assembly and Repair) is under the direction of Commander A. C. Miles, with Commander I. D. Wiltsie, Planning Sup't. Here some 1500 men in A & R turn out about 30 planes per month completely overhauled. When the wide range of types overhauled is considered, it becomes obvious that this is a major accomplishment. However, as Naval Air Service operations expand, this figure will be further increased. Installation of additional equipment and further personnel training work is steadily increasing the capacity of overhaul shops. Careful scheduling of operations keeps equipment flowing into the shop for overhaul at a steady rate. Field operations are supervised by Commander M. T. Seligman, Operations Officer, and Commander T. D. Gunn, Assistant Operations Officer. With more than a plane a day coming through the shops flight test work is an important assignment in itself.

The entire Pacific area is served by the North Island maintenance base. While there are a number of maintenance shops at other Naval Air Stations on the Pacific, the responsibility for supervising and maintaining these shops fall on the North Island base. Maintenance methods and equipment are standardized for the entire area by North Island, and considerable shop equipment work, repair and overhaul for the other stations is performed at North Island.

Planes maintained from North Island include all Navy types, both ship and shore based, carrier and cruiser types, landplanes, seaplanes, and flying boats. Shop arrangement is more or less conventional, except for size. Separate shops are operated for sheet metal, welding, wood repair, engine, and accessories. The latter shop if further subdivided into radio, electrical and hydraulic equipment.

While a great deal of John Taxpayer's money has been invested in the expansion and re-equipping of North Island, this money has been wisely spent. The maintenance facilities provided have been generously buttered with good old Yankee ingenuity such as no money could buy. Throughout the entire system of shops is found evidence of the mental alertness of the men at the top and the men in the shop. This is evidenced in too many little ways to bear detailed description.

Ingenuity is also shown in handling of small parts, as the small parts repair shops are arranged alongside but just outside the parts storeroom. Here repairs can be performed and the parts fed directly into storage. Parts handling and storage is made easy and fool proof by means of appropriate tagging, and by a simple system of records which follows the parts through the various shops and brings them back to their proper place to the plane under overhaul.



A part of the Cabin supercharging or "altitude conditioning" equipment of a Boeing 307.

Loading Charts

(Continued from page 73)

units and that the operation groups charted may have to include one for almost every type and size of machine

After determining the man- or machine-hour capacities by operation groups, the next thing for the job shop to do is to analyze all the open orders on hand, together with the estimates covering their operation times, and to distribute the man- or machine-hours by operation by due dates for plotting—after necessary adjustments are made on the loading chart.

The first hurdle to get over may loom up right here If the estimator systematically breaks down and records the time by operations on the jobs he is bidding, then it is a simple matter for the chartsman to dig up the estimator's memorandum when the order comes in. But when, as in some shops, the estimating is more of the nature of "guesstimating", with the estimator going by a sometimes highly developed "feel of the shop" to set a money price on the job after glancing at a blueprint of the part, it may be necessary at the start to resort to arbitrary percentage breakdowns assigned to various types of work such as machining parts from bar stock on a turret lathe, or on an automatic, or doing mill jobs such as machining forgings or castings, which must be bored, mill faced, drilled, and burred.

Starting on this basis and only seeking detailed breakdowns from the estimator on complicated or especially important jobs, it will be found that the loading chart itself will generally serve to bring this matter into adjustment

For organizing the estimated times of operations by due dates, a work sheet for each part is convenient, something like that shown in Figure II, which was drawn up to fill a double purpose but has served well enough for a man-hour organizer Filed in part number order in a ring binder, one for each factory, these work sheets can be used to combine all the separate orders for the same part Horizontally from the box marked "Delivery schedule" each separate lot is entered on the work sheet, showing the due date, with the number of parts required underneath it. In the same columns as the lots, under the heading "Estimate of Man-Hours", and opposite the operations shown at the left, the chartsman enters the estimated times of operations on the particular lots. To arrive at these times the operations to be performed are noted down in spaces provided at the bottom third of the sheet, together with the unit times taken from the estimator's memoranda; or an arbitrary percentage operation breakdown is applied to the bid price, which is assumed to be at so much per hour These unit times multiplied by the number of parts in the lots, plus set-up times give the estimated operation times to be spread in the columns of man-hours

The advantage of this work sheet for storing the loading data becomes apparent when the charting process is studied First, the times of all new orders are checked off once as they are distributed by operations by the weeks in which delivery falls due In the beginning all open orders are thus distributed on ordinary column sheets and then added on the day of making up the summary chart, to determine 'net load," by due dates After the first charting, new orders first written up on work sheets, bring in additions accumulated during the week on this distribution sheet Then these additions, less the estimated times of operations of jobs completed, are added to form the new net load

Notice that the work sheet is available to furnish the estimated times of operations on completed jobs The items are checked off on the work sheets again, actually for the third time, as completions occur and are listed on the distribution sheet

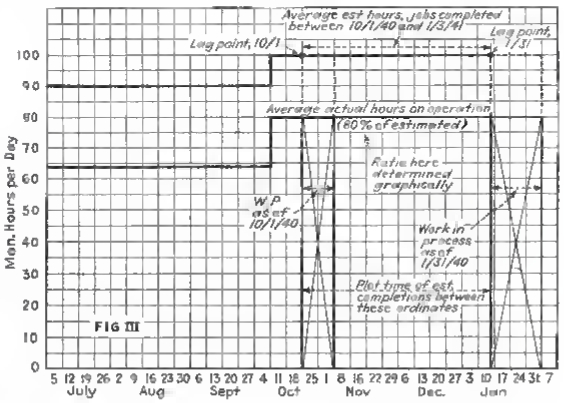
The items on the work sheets are given the second check when material and tooling are found to be available This the chartsman does when a new order comes in ready to run. But if something is missing he sets up a colored tab on the work sheet and starts a follow-up on the item at once This may save precious time over the old way of allowing the order to lie around until the shop has a machine open and the foreman tries to run that order only to find, too late, a fixture short, material missing, or the wrong blueprint on hand

The reason the estimated times of operations on completed jobs are distributed by due dates and subtracted weekly from the load, is that the chart should be "unloaded" the same way it was loaded to compensate for errors and discrepancies and to keep the summary chart always showing the true load picture

One very important point comes in here As distributed, the net load is on an estimated time basis It is necessary to determine the average relationship between the time estimated to do the work and the actual time taken in the shop Otherwise judging unfilled capacity by comparing the height of the load line with that of the capacity line on the chart may be very unsatisfactory For instance, if the actual time on an operation is averaging twice the estimated, charting estimated load could show the shop half full on the operation when in fact it is up to capacity On the other hand, if the actual time were averaging half the estimated, the chart might show full capacity when the shop is but half full

These conditions turn up in practice and should be taken into account If one operation is bid high, and is carrying another, which is bid low, that may not be all there is to it. The shop may be losing desirable work which would largely go on machines on the high-bid

(Turn to page 134)



A typical "working chart" carrying a continuous record of performance for a single operation

(Continued from page 132)

operation now standing idle, while it is getting too many jobs confined mostly to machines on the low bid operation.

But first it is necessary to bring such conditions to light. For purposes such as this, in addition to the weekly summary chart showing the up-to date net load by the weeks the work must be done to meet delivery schedules, there is a "working chart" for each operation, which carries a continuous record of performance. Even though the output figures may be shown on the summary chart as indicated in Figure A, on the working chart three graphic values are definitely combined. First the average actual man- or machine-hours per day are plotted. Second, once or twice monthly, except when the shop has particular facilities for getting the information weekly, the actual hours put in on jobs still in process are plotted under the average daily man-hours-in-the-shop line for the given operation extending back as many days as may be required. This number of days is in effect the graphic lag of the completed jobs behind the calendar. To put it differently, the completed jobs will plot under the actual time line up to the area representing work-in-process. See Fig. 1. From this it can be seen that if between the "lag points" of two work-in-process areas taken, say, a month apart, we plot the estimated time of operation of the jobs completed during the period between the dates the work-in-process figures are calculated, then we can get a direct ratio or percentage relationship between the average actual times and the average estimated times, on work completed.

This ratio, which reflects estimating errors, changes in procedure, gnef on operations, improvements in tooling, etc., may be applied as a corrective factor to the estimated net load for the summary chart, so that the load shown will be on an actual time basis the same as the capacity line. The factor itself may be corrected whenever work-in-process is figured.

In plotting the load on the summary chart, where man hour output data are shown to the left of the vertical line defining the date of the chart, it is advisable to place any past due load on top of the normal load immediately to the right of (after, in point of time) the chart date line, showing the shop full up to capacity on the particular operation for as long as will be necessary to work off the past-due load. Thus, graphically, the fact is shown that no more orders for immediate delivery can be accepted and worked on, without sacrificing some already on hand, until the past-due load is worked off.

This brings up the use of the chart to the estimator, who acquires the habit, if he hadn't it already, of finding out the due date of a job before he bids on it. Why waste time estimating jobs the shop can't handle? A bid accepted becomes a promise to deliver certain man or machine-hours. The chart tells the estimator what hours are already earmarked for delivery, serving as a mechanical memory in what at times can be a mechanical madhouse.

On the weekly summary chart the live load may be indicated as the number of days' work available for immediate operation by the shop. In the light of the huge program now in the making, with orders for deliveries extending far into the future, with material not all furnished at once, it becomes important to keep track of whether the live load is being maintained with a margin sufficient to keep all the machines going.

In effect the live load margin represents a reservoir from which there must come an adequate range of work to fit the different machines in the operation groups. If this range does not obtain, even with several weeks margin of live load on hand, there may be reason to consider breaking the group affected into smaller units to maintain better control. On the other hand, if the live load margin begins to shrink, this feature of the loading chart serves as a warning to get more work into the shop on which material, tooling and information are available.

As a further step in effecting cooperation between shop and factory, upon receipt of new orders the chartsman is in a position to mark up and return acknowledgments of purchase orders, showing the delivery date the shop is expecting to meet, putting it squarely up to the factory whenever orders with due dates impossible to meet are received. This is particularly necessary on orders marked "Rush", 'As soon as possible", "Immediately", etc. It is better to contact the factory at once, rather than wait until a serious delay develops.

By showing the picture of man-hours earmarked for work on the various operations according to schedule requirements, encouraging the factories to make it their business to keep the load up to capacity week by week and month by month, and by serving to help clear up order deficiencies, the loading chart becomes a sort of silent negotiator, sitting in with shop men and factory buyers on their mutual efforts to get out on time enough aircraft parts to serve the national defense.

(This is the second of a series of three articles on loading charts by Mr. C. W. S. Parsons. Part III will appear in the next issue.)

Shock Absorber Design

(*Continued from page 81*)

with an annular orifice the area of which during the stroke can be controlled by suitable means, such as a metering pin or a decelerating tube. This device, by varying orifice area, permits even dissipation of absorbed energy, and thus prevents instantaneous building of excessive loads, which usually causes severe bouncing.

Although many successful landing gear struts were designed with plain orifices without metering pins the device helps materially to smooth out the errors of the original design and to dissipate the energy stored in the strut in any desirable manner such as even dissipation, gradual increase, or gradual decrease. A strut equipped with plain orifice may indicate objectionable "peaking" of the load deflection curve in which case a proper metering pin should be used. Many formulas exist for the orifice and the metering pin design although the net area of the opening is usually subject to redesign as a result of dynamic testing on a rig.

In the pneudraulic type of shock absorber the typical load deflection diagram as shown in Fig. 3 embodies both curves, first of hydraulic restraint of the fluid rushing through the orifice, which is a function of the piston speed and orifice area, and the second the adiabatic curve of compressing gases under changing temperature.

$$P_1 V_1^k = P_2 V_2^k$$

Strut Action in Landing

When the airplane is approaching the ground the strut is in a fully extended position due to the air pressure in the upper chamber and due to the weight of the lower part of the landing gear. When the airplane tire touches the ground and begins to deflect, the column stress in the extended strut causes it to compress, which in turn forces the fluid through the orifice into the upper chamber. The hydraulic restraint of the fluid rushing through the orifice and the adiabatic compression of the air absorb a greater part of the input energy on landing and dissipate it in the form of heat. The remaining energy is partly dissipated by the tire, by the friction of the moving parts, and deflection of the airplane structure, the undissipated part of the energy absorbed causes a slight rebound. The energy absorbing phenomenon occurs within a fraction of a second between the first instant the tire comes in contact with the landing surface and the second instant when the center of mass of the airplane reaches the lowest possible point in its downward deflection.

On an airplane equipped with the conventional type of landing gear a marked rebound may be experienced on landing due to sudden decrease in angle of attack and consequent loss of lift. In this respect, the tricycle type landing gear with castering wheel far forward of the center of mass offers advantages since the wing lift force on landing experiences no abrupt change. This type of gear possesses other inherent qualities such as ease on landing regardless of wind direction, take off altitude at the start of a run, and the ability to use full brakes before landing and during the entire run without the danger of nosing over. The tricycle type landing gear imposes higher loads on the nose wheel as compared with those on tail wheel, particularly when full main wheel brakes are applied, even though the tail loads on landing tend to minimize the impact force on the nose wheel. This condition in turn demands a more efficient nose wheel shock absorbing unit.

In ordinary landing and during taxiing on a smooth concrete runway the energy input is usually so low that the load factor hardly exceeds 2.5g. In rough landing, however, such as may happen in an emergency descent upon rough terrain, blind landing, landing on deck, "pancaking" into small field, or landing upon a field located at high altitude, the input energy may be exceedingly high, and the shock absorber is designed to meet such an adverse condition and to dissipate efficiently the maximum possible energy input.

The total Input Energy on landing will be:

$$E = \frac{Wv^2}{2g} + Wh \qquad (1)$$

Where: W — airplane weight
v — vertical speed at the time of contact
h — total mass travel after tire contact

$h = t + s_v$

Where: t — tire radial deflection
s_v — vertical component of strut stroke

The total input energy, the energy to be absorbed by the airplane shock absorbing system, and the rate of energy dissipation are the functions of the airplane vertical speed at the instant of the tire impact against the landing surface.

Besides adequate energy absorbing capacity the shock absorber should also possess high energy dissipating capacity, so that no violent rebound occurs on rough landing. The energy dissipating capacity of the shock absorber ultimately determines its efficiency, hence, with higher landing gear efficiency the less bouncing on landing.

The properly designed shock absorbing unit should provide maximum strength for minimum weight, maximum efficiency, average mass travel after contact, even resistance during the entire stroke, smooth springing qualities and an automatic adjustability to meet different landing and taxiing conditions. Although the efficiency of the present day pneudraulic shock absorber may reach 85% on drop test rig, it is conservative for all preliminary calculations to use efficiency factor of 75%. The inherent energy dissipating quality of the modern pneudraulic type shock absorber permits severe landings without violent rebound and with the maximum load factors from 50% to 70% smaller than those experienced with the old type.

Taxiing

In so far as design criteria can be set up for landing conditions, no definite requirements exist for design load factors in taxiing, although when taxiing on rough fields at high speed the undercarriage may experience higher loads than on landing. This phenomenon may be justly attributed to the fact that on landing the vertical compouent of the wing lift force helps materially to decrease the initial impact load, the condition that does not occur during ordinary taxiing.

In moderate taxiing the strut air bears the entire compression load since the piston stroke and the velocity are so low that no hydraulic action takes place unless a longer stroke occurs when rolling over an obstacle. For the sake of comfort and reduced wear on the airplane structure the shock absorbing system must have adequate smoothness in taxiing. A good many struts that indicate high efficiency on test rig prove to be rather stiff on taxiing while in service. The tire, having low energy dissipating capacity and being virtually an undamped air spring, tends to oscillate freely during the taxiing. If the tire oscillations synchronize with those of the air strut the compound oscillation of the system will build up excessive loads. In this respect the air spring of the pneudraulic strut has a decided superiority over the steel spring because its load deflection rate and the rate of oscillation can be adjusted by varying static air pressure.

(*Problems and solution on shock absorbing, using this material will appear in an early issue*)

Private Owner

(*Continued from page 126*)

ascertained. All control surface hinges or supports should be checked for wear and should be oiled. Any unusual wear or looseness of fittings should be corrected

The airplane should be lifted and the landing gear checked for loose bushings or worn bolts. Also a careful check must be made of all fittings for cracks or strains. In general, this is a period at which such inspection should be made and repairs effected that would keep the aircraft in a suitable state of repair for re-license, and, if it is done carefully, the ship will always be in an excellent flying condition. I note this particularly because a great many owners will have this inspection made only at re-license time and find that much expensive work has to be done that could have been more economically done had the defects been observed earlier. Regular inspections made throughout the life of the plane always save money.

Service Suggestions

Propellers

It is important on wooden propellers that they be kept varnished so that moisture may not enter the grain and cause rot or separation of the laminations. Severe nicks should be smoothed down and re-finished. Tipping rivets should be kept tight by re-soldering, although when such soldering is done, care should be taken that the balance is not disturbed. Nicks in dural blades should immediately be filed out until any rough edges are gone and then finished smooth with crocus cloth. This is a most important precaution as these blades are subject to high stresses and a jagged edge may always be the origin of a fracture which in a very short time might cause the loss of a blade tip and a resultant crackup. If any area is suspected of having a fracture it should be smoothed down and a local etch applied. This etching material is a 20-percent solution of caustic soda rubbed on or applied locally and allowed to stand until the material darkens. It should then be removed by a 20 percent solution of nitric acid. If a crack is present it will show up as a distinct black line. The acid should then be removed by washing with warm water. In case of steel blades severe nicks should be filed out and smoothed down, with the precaution that very little metal may be removed. No welding may be done, but if the nicks are severe enough, or any crack appears, it should be returned to the manufacturer. It is most important that propellers always be very tight and if any roughness of the engine should occur this point should be immediately checked. All repairs to propellers should be made only at approved stations and no straightening of duralumin blades should be attempted in the field.

Magnetos

In the checking of breaker assemblies minor adjustment of the contact points should be avoided unless facilities are available to polish the contacts. If the points have been mated by running, a minor turning of the adjustable point may cause contact to be made by a very small area with the result that it will burn and become irregular. If adjustment is necessary the points should be completely removed and polished to a high finish in a fixture that will allow it to be perfectly square when completed. It is important that the axle for the breaker lever should be replaced if worn as this will allow misalignment of the points with resultant burning. If it is ever necessary to replace a coil, immediately on removal of the coil a piece of metal should be placed across the pole shoes. If this is not done and the engine should be turned it would be possible for the magnet to lose its force. The improved type of breaker assemblies with the pivotless breaker requires no care between overhauls except to see that the points are not burned. These should not be gone into unless complete instructions are at hand. In connection with ignition, it is important to see that all shielding is tight and that on the wires each end is well grounded. A loose ground at one end of an ignition wire may cause failure of the insulation, causing a miss that is very hard to locate. Spark plugs should be kept adjusted to a minimum gap, not only for engine efficiency but because a wide gap may create radio interference. It has been found, too, that where ignition systems are shielded that it is desirable to set the points at a minimum clearance rather than approach the maximum.

Analyzers

Fuel-air mixture indicators are a necessity where constant-speed propellers are used. They are a delicate instrument and their accuracy depends upon proper maintenance. This should be done at not more than 50-hour periods, and oftener if the time is such that the wick or wool will dry out. One item that is most important in the checking is to allow the instrument to set at least one hour with the current on. If this is not done the instrument may creep after adjustment and give an erroneous reading.

Generators

Most generator trouble that occurs in the control box, and this should be checked every 100 hours to see that the cutout points are clean and that the regulator points are not burned. No adjustment should be attempted unless the repair man has a good voltmeter available and thoroughly understands the procedure of adjustment. In case of radio interference from the generator, it can usually be helped by attaching a 1-microfarad condenser from A plus on the generator terminal to ground.

Instruments

With the increase of instrument flying it is most important that all of the instruments be kept in a perfect state of repair. This can only be done by agencies that thoroughly understand them and have the proper equipment for their repair and calibration. Therefore, little can be suggested except to take them to such an agency.

One common trouble, however, is in the case of airspeed lines. These frequently become clogged or develop leaks, in which case three instruments may be affected—the airspeed, climb, and altimeter. If trouble is observed on these three instruments, both the lines should be disconnected from the airspeed and blown out. Be sure and disconnect them first. After making sure that they are clear, they may be connected again. Then blowing into the open, or pitot, tube *very gently* bring the indicator up to near its top limit and hold with the tongue or by clamps on a rubber tube and check for leaks. If the hand falls back it indicates a leak in some connection. It should remain stationary or nearly so. If it should show that a leak is present, check all connections from the instrument out to the pitot head and any leaks should be corrected.

To check the static line, it should be disconnected from all of the instruments and a spare airspeed used as a leak tester. It is not advisable to put any pressure on the static line when attached to the instruments, as the climb indicator is too sensitive on gyro instruments, which include turn and bank indicator. It is necessary that they operate under the correct pressure so that a suction gage attached to them is a very desirable instrument. If the suction is not known they should not be entirely trusted until an instrument man has been able to check their suction and operation.

In conclusion, the maintenance of an airplane should be kept entirely in the hands of people who know what they are doing. This may be a mechanic at a small field, or the pilot himself, or a large repair station, but owners should make sure that whoever may do the work is careful, thorough and competent.

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Inflation

(*Continued from page 71*)

terest to note that the average rate of return of 34 4 percent in 1939 represented individual rates ranging (low to high) from a loss of 60 5 percent, for one corporation, to a gain in rate of return of 98.8 percent for another corporation.

During periods of business recovery, an increase in union activity invariably occurs Wage demands and threats of strikes have already developed in a number of aircraft plants

With aircraft plants operating at capacity levels, labor may be asked for more hours of work but without compensation of time-and-a-half for any time over 40 hours a week. It is significant that under the Walsh-Healey Act of 1936, the President is authorized to suspend the provisions requiring payment of time-and-n-half as indicated on government contracts for supplies and equipment which equal or exceed $10,000 The President has not invoked this authority

Wage adjustments will undoubtedly be made which will result in higher operating costs for the industry

With a record-breaking period in passenger traffic, the air transport industry more than doubled its earnings for the nine months to Sept 30, 1940, as compared with the like 1939 period Aggregate revenues, before provision for federal income taxes totaled more than $5,000,000 for the January-September 1940 period as contrasted to about $2,500,000 for the corresponding months in 1939 By way of comparison, earnings, for the full 1939 calendar year, before income taxes, totaled about $4,000,000. Net income after taxes aggregated slightly less than $3,200,000 Profits for the industry for the full year of 1940 may easily approximate $6 500,000, before federal income taxes It must be recognized, however, that during last year, the normal tax rate was 18 percent as compared to 24 percent at present On the latter basis, net income for the industry as a whole for the current year may total about $4,950,000 While a new high, such results would be materially below the fantastic estimates advanced earlier this year by over-enthusiastic prognosticators.

Predicated primarily on a strong earnings trend, the expanding air transport industry continues to obtain additional capital with lessening difficulty. The bulk of this additional money is being applied towards new equipment purchases with the balance of such funds going towards that catch-all—"for other corporate purposes"

The successful offering of 50,000 shares of preferred stock by American Airlines vividly illustrates the startling improvement in the credit status of that carrier and possibly of the industry as a whole, as compared to a number of years ago While American received only $102 a share for this preferred stock, it was offered at $105 to the public but immediately went to a premium at $109 Convertible into common stock at $70 a share, this preferred can be expected to experience considerable buoyancy in direct ratio to the market action of the common. American used the proceeds from this financing to retire a $2,250,000 2½ per cent promissory note and for new equipment purchases as well as for other corporate purposes.

The ease in which American marketed this new stock issue is a far cry from the financing problems encountered by the company during its earlier days Back in late 1935 and early in 1936, when American embarked upon its ambitious equipment buying program, the banks refused to finance the purchase of transport planes on the premise that aviation was too risky and that the resale market for used planes was limited Whereupon, American applied to and obtained from the Reconstruction Finance Corp total loans of $1,036,000 at 5 percent to finance its initial purchase of 20 D C. 3's costing $2,060,000 The company, in other words, at the outset was forced to have a 40 percent equity in this equipment Moreover, the RFC took a chattel mortgage on this equipment and provision was made to amortize this indebtedness over a four-year period through monthly payments

What a contrast American's present-day financing methods present! About five times the amount of the original RFC loan, without any chattel or security whatsoever, was obtained solely on the credit and position of the company Instead of paying a fixed interest rate of 5 percent, the company is merely commited to pay a return of slightly more than 4 percent, albeit cumulative, only when earned Absent too, is the down payment and compulsory amortization feature to retire the issue It is likely, however, that this new preferred will in any event be extinguished in due time through conversion into common stock.

The common stock of American Airlines is slated for considerable dilution in the near future While 361,836 shares of common were reported outstanding as of Sept. 30, 1940, the anticipated conversion of the company's 4½ percent debentures totaling $2,500,325 into 200,026 shares on or before July 1, 1941, should augment the common stock outstanding to a total of 561,826 shares. The significance of this conversion can be seen from the fact that earnings for the nine months ended Sept. 30, 1940 would have been equivalent to only about $2.77 share on the 561,862 shares to be outstanding instead of $4 30 on 361,836 shares as actually reported

Transcontinental & Western Air used a new and novel form of financing for the air transport industry when it arranged for a four-year unsecured revolving credit Under this agreement, TWA is permitted to borrow, as its actual money requirements develop, in varying sums from $2,500,000 initially, graduated downward annually to the expiration of the agreement on Dec. 31, 1944 The interest rate specified is 2¾ percent per annum. In this manner, funds will be provided for the purchase of new airline equipment, principally 15 new 24-passenger D C 3's This type of financing has certain desirable attributes in that it provides flexibility and assures the airline of adequate funds without the necessity of fixed borrowings.

Pennsylvania-Central Airlines also recently experienced a successful stock flotation when it sold 60,000 shares of additional common stock. Approximately $850,000 was thus realized by the company Of this amount, about $230,000 was applied towards the purchase of two Douglas D C 3's and the balance of the proceeds added to the company's general funds as additional working capital

In its second public stock offering within a year, Mid-Continent Airlines, Inc, sold 100,000 additional shares at $5 per share. After deducting underwriting fees and expenses, the proceeds were applied to finance the purchase of three airplanes, as well as for debt retirement and for other capital purposes An additional 40,000 shares owned by the president of the company were also delivered upon the exercise of certain warrants. However, this latter transaction did not represent any additional financing for the company, but was merely a private transaction between the underwriters and the president of Mid-Continent.

Reliable sources indicate that Boston-Maine Airways, Inc, may shortly offer a new stock issue to the public. Proceeds of the stock issue would be applied towards the purchase of new planes and for working capital purposes

	Barron's Aircraft Average	Barron's Air Transport Average	Barron's 50 Stock Average
Oct. 18	39.45	28 41	78
Oct. 25	39 75	28 41	78
Nov. 1	42 15	29 16	79
Nov 8	41 70	28 44	62

S.A.E. Meeting

(*Continued from page 65*)

prior to starting assembly operations, thus making sure there are no shortages which may bring costly delays of the whole assembly line. A solution to the problem of efficient mass assembly operations is found by rigid adherence to the five following rules: 1. Develop accurate bills of material. 2. Schedule engineering, procurement, and production—and then hold to the schedules. 3. Have erection lists prepared by the engineering department with the help of the shop. 4. Use tote pans for material distribution along the assembly line. 5. Use progressive fixed station assembly, completing all operations before advancing from one stage to the next. It is also suggested that key men be given a bonus for intelligent supervision.

Discussion brought out the importance of close cooperation between shop and engineering at all stages of production, including especially the development of tooling.

T. P. Wright, in an introduction of Rossmann, pointed out that aircraft production would never be directly comparable to automobile production, since the highest conceivable production of a single type airplane could only reach a figure of about one per cent the normal daily rate of production of a large automobile factory. This is determined, Wright said, by the nature of military tactics which require provision of a relatively large number of different types of aircraft. Rapid advances in design must also be made in order to match the performance of enemy planes, preventing freezing designs for long production runs. However, there are many lessons to be learned from the automobile builders and Rossmann, with long experience in the automobile industry, should bring aviation much valuable production data.

"Engineering Considerations in Aircraft Design to Permit Application of Automobile Mass Production Methods," by Don R. Berlin and Peter F. Rossmann, was presented by Rossmann. Much of the value of this paper was in the large number of excellent slides shown, illustrating automobile mass production technique, and also giving many examples of the application of automobile manufacturing ideas to aircraft production problems. Several points made can be summarized as follows. 1. Provide the engineer with more latitude in design through extension of manufacturing technique. 2. Pay more attention to inspection as a production process. 3. Provide better cost analysis and cost regulation. 4. Install more exact production control. 5. Improve production tooling by: (*a*) Properly planned operation sequences. (*b*) Simple, fool-proof jig and fixture design. (*c*) Gaging and locating points common to mating parts. (*d*) Non-fatiguing work heights and positions. (*e*) Reasonable applications of time and motion studies. (*f*) Provision of adequate inspection tools.

In the discussion period it was emphasized that production could be speeded, as a general rule, by eliminating hand work and providing mechanical material handling equipment. The need for reducing man-hours used in aircraft production was illustrated by comparing the 8,000 man-hours used to produce a typical pursuit airplane with the 106 man-hours per car which is the rule in the automobile industry. To obtain high production, tolerances must be held more rigidly rather than less so. Subcontracting must be limited to firms that can meet tolerances. Interchangeability must be an inflexible rule.

Information on stainless steels and magnesium alloys was given at the materials sessions, with J. L. Atwood serving as chairman.

"Some Uses of Stainless Steel in Aircraft Construction" was read by Oliver Fraser, Jr., of the Carnegie-Illinois Steel Corp., while "Magnesium Alloys in the Aircraft Industry" was presented by J. C. Mathes of the Dow Chemical Co.

These two papers presented two divergent philosophies of aircraft design. On the one hand stainless steel leads to the development of highly stressed thin skin structures of built-up design. At the other extreme is the low stress thick skin magnesium structure of relatively greater simplicity, tending towards the monocoque form without internal bracing.

A plea for simplification of stainless steel specifications was voiced by Fraser, as well as an excellent outline of the technique and procedure of steel manufacture. It is especially important that the steel mill shall know as far in advance as possible how much of what specification steels the industry will require. Availability of stainless steel alloys provides the industry with a structural "cushion" in the event we run short of aluminum materials. Out of a long personal experience in designing and building aircraft parts of stainless steel, Fraser gave encouragement to those now working with, or designing in this material. Its high strength characteristics make it particularly suitable for some of our new very high performance aircraft with heavily loaded wings, especially in cases where the wing is relatively thin.

Mathes told his audience that it is not true that German interests have hampered the development of magnesium alloys in this country. American magnesium is being produced under American patents and with American money just as fast as physical limits of men and machines permit. Production has been doubled in the past twelve months and will double again in the next twelve months. Applicability of magnesium alloys is being extended rapidly to aircraft structural problems. Shortly a considerable number of planes will be flying on a test program equipped with magnesium sheet wing coverings. Magnesium forgings and extrusions are now being made. Hot pressing of magnesium sheet has been developed very satisfactorily and shapes may be pressed or drawn about as well, and to as wide a range, as with aluminum alloys. Among developments with magnesium materials is the trend to pure monocoque structures of very smooth surface which results from the use of thick skin sections which do not warp or wrinkle. Units have been built without any internal brace members whatever which compare favorably on a weight-strength basis with conventional structures, and which are appreciably cheaper to build. Aerodynamic efficiency of such structures, which can be made to take a high polish, will increase even more as we develop laminar wing flow at high speeds. Improvements in purity of magnesium alloys, and anodizing of magnesium surfaces, has greatly increased the resistance of magnesium alloy parts to weathering.

Vapor Lock Problems

Engine papers were presented to two sessions with Mac Short, president of Vega Airplane Co., acting as chairman of one and Dr. A. L. Klein, California Institute of Technology as chairman of the other. The annual report on vapor lock problems, by Dr. O. C. Bridgeman, director of the C.F.R. project, summarized the 33 reports which have been made during the past year. Four approaches of the problem have been studied. 1. By controlling characteristics of the fuel to lower vapor pressure. 2. By fuel tank supercharging to insure flow at all times. 3. By fuel cooling. 4. By compromise methods. The fourth method is that used by engineers to solve each new fuel system design problem and does not represent a fundamental approach. Its application has reduced vapor lock troubles somewhat, and extended scope of operations, but the problem has not been solved. The first method is not considered promising since it produces a number of unfavorable results. The second and third methods are both

(*Turn to page 148*)

Standardization

(*Continued from page 67*)

using extruded shapes in his designs, at least one complete set of drawings covering all available extrusion dies shall be located in each drafting room

Standardization can be affected in the Stress Analysis and Weights Departments by adhering to a uniform series of values, formulas, forms and methods of procedure in their respective lines of calculation This information, also, should be made available in manual form

In the manufacturing department every effort must be made to follow standardized methods of processing Such a procedure will make it easier for large quantities of aircraft parts, or even of complete planes, to be simultaneously manufactured by a number of different companies

In the field of accessory manufacture, the builder of a standardized item knows that, even though there may be no market for his product when first introduced, the market is sure to develop And when the demand does develop it will not be restricted to a few customers only. Higher production permitted by wider distribution will lower costs. Such wide distribution will simplify the problem of dealer stocks, and also the problem of maintaining stocks of replacement parts for service needs

While standardization can be advantageous to almost any branch of design and production procedure, there is little advantage to be gained in the standardization of parts used only in special applications

Also, it is futile to standardize a part where conditions indicate that further improvement is necessary for satisfactory functioning

Standardization work has been greatly advanced in the aircraft industry through establishment of the Western Aircraft Standards Committee, on the West Coast, followed by similar action on the East Coast These committees will continue to function and their work will be assisted through formation of the S.A.E Aeronautical Standards Board Through this work the following aims are being realized: 1, To provide means for cooperative establishment of new aircraft standard parts which will supplement the Army Navy Standards for use on both Service and commercial aircraft 2 To provide means for the establishment of exchange privileges covering certain processing tools and equipment (such as the extrusion die pool) 3 To provide means for the exchange of certain unrestricted engineering information, such as tests reports, research data, etc

In conclusion the author points out that now is the most opportune time that has yet presented itself for full cooperative action in the industry on the problem of standardization, and urges that all firms give a more serious consideration to greater effort in this field

Standardization of Aircraft Engine Components was the concluding paper of the session, presented by Gustaf Carvelli, Wright Aeronautical Corporation The author has developed a number of charts and drawings to illustrate his points relating to engine standardization. Since standardization must start in the drafting room it is necessary to provide a uniform system of dimensioning and placing data and notes on the drawing To do this a sample drawing is provided for each type of part in the entire engine, such as connecting rod, piston, crankshaft, etc Such sample drawings are filed in such a way that the draftsmen can select the proper sample by reference to a list showing the sample drawing number together with suitable remarks

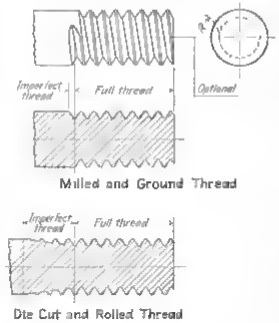


Fig 5. Illustration of two types of end threads.

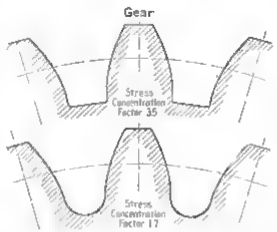


Fig 6. Using a 20 deg tooth form and a full radius at the root to decrease stress concentration.

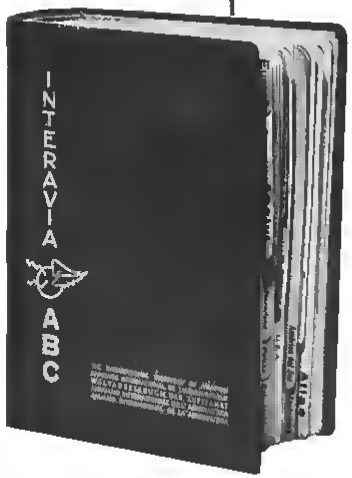
To simplify dimensioning of parts a two place decimal system is recommended for the engineering and production departments, in place of fractional dimensioning still commonly used. In some cases parts dimensioned to the fractional system must have the fractional dimension converted to decimals as many as eleven times The decimal system facilitates the work of layout men, detailers, checkers, tool designers, tool design checkers, pattern layout men, pattern makers, layout men of castings for checking, layout men of first casting for machining, layout men for tools, and checkers of tools. The importance of standardizing on the decimal dimensioning system becomes apparent when it is realized that in a large organization when any of the common fractions are in use the change to decimals must be made thousands of times daily The saving in man hours through use of the decimal system is positive and substantial There is no serious drawback to use of decimals For example, the fraction 11/64, to be expressed clearly would have to be carried out six places to read .171875, but the two-place decimal equivalent .18 is entirely satisfactory To simplify, a conversion table, such as is shown in Fig 2, is provided throughout the drafting room and shop, for converting 16ths, 32nds, and 64ths to two place decimal equivalent

Standardization of notes on drawings is important A simple item like breaking edges of a drilled hole for instance may prove costly if not properly treated

The accuracy of studs, and of tapped holes must also be closely controlled by properly standardized notes, as many parts of an aircraft engine are held together with studs The accuracy of various surfaces with relation to each other, such as on gears, splines, and threads, can be controlled by a single "A" note form properly interpreted Accuracy of a crankpin or highly loaded journal should be controlled by a "Z" note specifying the circularity and taper of the pin Heat treatment of small parts is controlled by specifying one of six degrees of Rockwell hardness, which system helps the production department to heat treat many different small parts at the same time. The heat treatment of larger parts, such as crankshaft or camshaft is controlled by a Brinell reading note .005–010, or .010–015 for very thin sections, .015–25 up to .055–065 for general work, .025–045 for crankshafts .035–0 65 for cams

One of the first major parts to be standardized was the propeller shaft end. Shaft ends S.A.E. No. 10 to 50 inclusive are of the straight sides spline type and the No 60 of the involute type spline It is suggested that any new or

(*Turn to page 148*)



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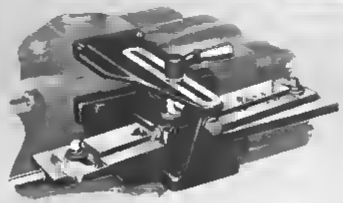

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S.A.E. Meeting

(Continued from page 144)

promising and further work is being done to perfect methods of fuel cooling and tank supercharging which, between them, should eventually solve vapor lock troubles

"Supercharged Aircraft Ignition Harnesses," by Carl E Swanson, Northwest Airlines, Inc, describes an ingenious system for pressurizing the ignition harness to eliminate troubles arising from water vapor oil fumes corona, formation of ozone, and nitrous oxide The pressurizing equipment weighs very little and has completely eliminated ignition harness troubles and greatly extended plug service periods Eventually it is believed the magnetos will be pressurized also, but they are not sufficiently air tight for this at present

E K Von Mertens, Pratt & Whitney Aircraft, presented a full description of the new Pratt & Whitney ignition system which solves the troubles which formerly required installation of pressurizing equipment The new system is designed as a single unit, with the ignition harness and distributor housing cast in a single piece The ignition wiring is built into the housing, producing a superior ignition system both electrically and mechanically

"Aircraft Engine Reduction Gears and Torque Meters" was read by Roland Chilton, Wright Aeronautical Corp Chilton described the new 20-pinion planetary reduction gear, which is 99 1 percent efficient as well as being compact and light in weight This gear also lends itself readily to incorporation of a torque meter in the gear housing Chilton pointed out that propeller drive requirements were growing daily more exacting

In addition to being light, compact, durable and highly efficient, some of the indicated future requirements for propeller drive are a Increased reduction ratios over a wide range b Compound reduction gears interchangeable for change of speed without change of gear housing c Provision of two-speed gearing d Reverse rotating coaxial propellers e Alternate right and left hand propeller rotation f Remote drives permitting buried engines g Provision of torque meters.

Two papers on supercharging might be considered more as a contribution to high altitude research, than engine research "Problems Relating to Control of Flow in Superchargers," by Nate Price, Lockheed Aircraft Corp, described a new cabin pressurizing control valve of particular value in regulating pressure so as to permit gradual adjustment of cabin pressure to ascent or descent of the airplane Considerable attention was also given to detailed design of centrifugal engine superchargers and suggestions made for improving efficiency through better speed control, provision of double shrouding of the blades, and application of a fan to the intake

"Altitude Conditioning of Aircraft Cabins" by J B Cooper, Boeing Airplane Co, was a report on experience gained in designing building testing and operating the Stratoliners which are now flying daily on the TWA transcontinental service and on the PAA service to South America Thoroughly satisfactory results are obtained with present equipment but numerous future improvements are indicated

John Lee Pratt & Whitney Aircraft, acted as chairman of the electrical equipment session The paper on "Auxiliary Power Equipment," by C C Shangraw, Eclipse Aviation, might have been classed with the engine papers, for a large part of the discussion ranged around the merits of mounting all accessories directly on the engine, or of driving all accessories from engine driven gear boxes The concensus of discussion and Shangraw's paper, was that auxiliary power will probably be used only in conjunction with the main engines, possibly only for ground operation and that such a system can be developed to eliminate batteries Everyone seemed willing and eager to get power for driving accessories from the main engines, rather then from auxiliary engines, since main engine power is lighter, cheaper and more reliable all other considerations being equal However, the problem of getting the power from the main engines to the accessories still remains There is insufficient room to mount them all on the engine proper Hydraulic drive and electric drive both present drawbacks and the mechanically driven remote gear box is heavy and bulky Great improvements in generator design partially through turning the generator at higher speed and cooling it with forced flow air, have made it possible to take considerably more electrical power directly off the engine

"Aircraft Electricity as the Airline Operator Sees It," by P C Sandretto, United Air Lines Transport Corp, is an effort to get a year ahead of the airplane design parade by forecasting a new type electrical system for aircraft of 100,000 lb size or over The Sandretto system would use four alternators on each engine of a four engine plane to provide 30 kw of power at an appreciable weight saving over conventional electrical systems

Standardization

(Continued from page 146)

larger shaft ends be of the involute type, which is more adaptable for large production with greater accuracy than the straight sides type, and which has a lower stress concentration factor The method of straight side splines was developed as an improvement over the old system of keying a gear to its shaft For many applications the straight side spline has proved unsatisfactory and a 20 deg stub tooth form was developed Both of these forms have high stress concentration at the root of the spline and the 30 deg involute type has been developed to overcome this Advantage of the 30 deg type is illustrated in Figure 3

Drives which have been standardized using the 30 deg involute spline are generator drive, accessory gear box drive, fuel pump drive, propeller governor drive, vacuum pump drive, and the No 60 propeller shaft end.

Parts are usually held together with threaded bolts, studs, or screws But the national screw form is satisfactory only under fixed load conditions, and not under repeated loads. For this reason a modified thread form has been developed for all highly stressed parts, as shown in Figure 4 Instead of allowing sharp corners a maximum and minimum radius is used Thus thread form has proved its usefulness for tapped holes in aluminum or magnesium, as well as for studs and bolts In the design of parts with threads it is often very important to control the location of the end thread Figure 5 shows two types of threads and this picture is helpful in guiding drafting departments in their selection of which thread to use When threads are milled or ground the end thread is as shown in the upper view, and when die cut or rolled threads are required they are as shown in the lower view

Many gears are used in an aircraft engine and many types of gears have been tried, but the 20 deg full depth tooth form has proved to be the most satisfactory The standard 20 deg tooth form has high stress concentration at the root since the fillet is only a few thousandths of an inch By using a 20 deg tooth form with a full radius at the root the stress concentration is decreased considerably as is illustrated by Fig 6.

In his paper the author attempts to show how many items need to be standardized, yet on which very little information has been published Referring again to the decimal system in the con-

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Sixty Planes a Day

(Continued from page 63)

neering, tooling and planning sections are so placed in relation to production as to permit close coordination. To provide straight-line unobstructed production throughout cafeteria, locker rooms and toilet facilities are located underground.

The plant is so 'obstruction free" as to assume a flexibility in the type of aircraft that may be produced Changes for varied designs of airplanes requiring new plant layouts may therefore be readily accomplished

Completion of the new Buffalo plant will increase to approximately 2,000,000 sq ft the total space to be devoted to aircraft production by the Curtiss-Wright Corp in the Buffalo area alone. The new unit will employ about 12,000 persons, and with the present plant which has around 9,000 workers, will increase to 21,000 the number of people employed in the Buffalo area

Following closely the design of the Buffalo plant, the new Columbus factory consists of a one-story manufacturing plant occupying about 1 200 000 sq ft. Like the Buffalo unit, it provides a clearance from the floor to the bottom chord of the roof truss of 20 ft, in the general manufacturing area, and 40 ft. in the sub and final assembly Beneath, a basement with 150,000 sq ft of floor space provides locker rooms, cafeteria, and storage space An engineering section, 100x900 ft, with basement under part of the area, providing space for employment offices, hospital, kitchen and storage rooms, and an office section consisting of a two-story building with full basement, 50x400 ft., and accessory structures, cover a total of 148,000 sq ft in addition to the main manufacturing plant.

The Columbus unit, under the supervision of J. A. Wilhams, will employ approximately 12 000 persons in the local area when the plant reaches full production. It will produce many of the aircraft types now manufactured by the Buffalo factory and, according to plans outlined by the management, will contribute greatly to the production quota of the Curtiss Aeroplane Division With the long experience of the latter organization in designing and producing military aircraft, dating back to World War I, and its success in recent years with manufacturing high performance pursuit types like the Curtiss P-36A and the Curtiss P-40 which have proved their mettle in foreign competition, the new Columbus plant will be placed in the full production within a minimum period

St. Louis Airplane Division

The St. Louis Airplane Division, of Robertson, Mo, linked for many years with the development and production of outstanding military, commercial and private aircraft types, including the recent 30 passenger Curtiss-Wright transport is now replacing its original plant with the largest aircraft factory ever built in the Middle West.

Over eight times as large as the present plant which occupies 149,000 sq ft, the new structure is very similar in layout and size to the Buffalo and Columbus units More than 27 acres of floor space are to be covered by the new building which is being erected on the present site of the St. Louis Airplane Division's factory Costing approximately $11 000,000, complete with tooling machinery and equipment, the new plant is being constructed of steel, brick and reinforced concrete.

Of unusual interest to those who are acquainted with the aviation industry's problems is the fact that during construction of the new unit, manufacturing operations are being continued and expanded in the present factory The general and engineering offices occupying a front of the main manufacturing plant, facing Lambert Field, will be completed first. As wings of the manufacturing plant are completed, operations will be moved so that it will be unnecessary to dismantle the present structure until all departments have been reestablished in the new and larger factory

Indicative of the size of the cargo transports and combat planes which the St Louis plant will be required to produce for the National Defense program when it is completed next spring, the final assembly department will be 200x600 ft and will have a ceiling clearance of 40 ft, completely free of obstructions. Two huge doors, each 200 ft wide, will extend along the west side of the building

The entire structure, with an area of 1,200 000 sq ft. will include a one-story manufacturing and engineering section, the office section of two-story construction, and accessory buildings When placed in full production, the new plant will increase employment from the present figure of 2,000 to approximately 12,000 workers

Altogether, upon completion of the plants now being erected by the Curtiss Aeroplane and the St Louis Airplane Divisions of the Curtiss Wright Corp production area will be increased from the existing 949,000 sq ft to about 4,400 000 sq ft. of floor space, and increase employment from the current 11,000 to nearly 45,000 people

Curtiss Propeller Division

Curtiss-Wright's fourth Division, Curtiss Propeller, of Clifton and Caldwell, N J. and Pittsburgh, Pa., has rapidly developed from a small department of the Curtiss Aeroplane Division into a large organization. Manufacturing the universally known Curtiss electric "full-feathering" propellers and Curtiss fixed pitch propellers, this Division has likewise been expanding its activities Its new plant, near completion at Caldwell, N J., will more than double present production facilities.

The latest unit, comprising 370,000 sq ft., adjoins Caldwell-Wright Airport near Caldwell Designed by engineers of Curtiss Propeller in conjunction with Albert Kahn, Inc, the one-story structure incorporates many new features in modern industrial design including actinic type of glass for assuring maximum daylight illumination. Now approaching full production, it will enable us to keep pace with the increasing mass production of aircraft engines and planes for the nation's Air Defense program

The Caldwell unit marks the latest step in that division's unusually rapid expansion From an extremely small organization with only 17,000 sq ft of floor space, it has developed into a full-fledged division with a plant at Clifton occupying 135,000 sq ft., which, with the acquisition last year of the hollow steel blade division of the Pittsburgh Screw & Bolt Co, now comprises 220 000 sq ft This area, together with the new Caldwell plant, provides a total floor space of 590 000 sq ft, increasing employment from 2,000 to approximately 5,500 persons.

In addition, the Curtiss Propeller Division is contemplating establishment of a fourth plant somewhere in the Middle West, the production of which will be somewhat in excess of the Eastern factories.

Throughout the whole Curtiss-Wright expansion program, we have kept the human equation to the forefront in our planning of additional facilities. Basically, we wanted factories without frills, but combining high productive capacity with the best of working conditions for our people For that is the first requirement in the foundation for efficient operation

Thus the new Curtiss-Wright aircraft plants are being geared to produce 8½ times as many fighter types as we are now manufacturing, and may be expected to deliver a total of 60 military planes a day when in full production for national defense.

German B.M.W.

(Continued from page 64)

the outside. The carburetor is located between the two blocks close to the intake manifolds so that distribution of mixture is approximately the same to all of the cylinders.

The supercharger is of the gear-driven one-speed type with a gear ratio of 8.2 to 1. It has two air intakes equipped with flame traps and a single large manifold leading to the carburetor. The carburetor is of B.M.W. manufacture and is of the multi-jet type with automatic mixture control and altitude control. Its shape and location are such that a multi-unit direct fuel injection pump can be substituted for it without difficulty. When using 87 octane gasoline in the carburetor the fuel consumption of the engine is 0.55 lb per hp per hour at maximum continuous output and 0.50 lb per hp per hour at cruising output.

The ignition system comprises two twelve-cylinder Bosch magnetos mounted on the accessory or rear section of the engine and two Bosch plugs in each cylinder. A Bosch hand and electric starter also is mounted on the accessory section where it can mesh with the rear end of the crankshaft. A tachometer drive is provided above the starter and drives are provided from the rear ends of the camshafts for vacuum pumps or high-pressure oil pumps. The centrifugal pump for circulating the cooling water is mounted underneath the rear part of the engine.

The propeller drive has spur gears which give it a reduction of 1.54 to 1 or 1.87 to 1. The gear housing is integral with the front end of the crankcase. The propeller shaft has the customary flange with eight bolt holes and serrations in accordance with German standards. A shell gun can be mounted to fire through the hollow propeller shaft by removing a cover plate just above the supercharger casing. Two attachments are provided on each side of the crankcase for mounting the engine in the airframe.

When operating on 87-octane gasoline the B.M.W. 116 has an output of 600 hp at 3,000 r.p.m. for take off and it develops this output at its rated altitude of 11,800 ft. At an altitude of 14,750 ft it has an output of 510 hp at 2,840 r.p.m. It weighs 1,003 lb dry which is equivalent to a specific weight of 1.67 lb per hp. This is quite a good performance for a medium-powered engine which has not been fully developed. The engine also can be equipped with a two-speed supercharger having gear [illegible] and 8.2 to 1 which increases its performance.

In addition to the B.M.W. 116 B.M.W. Flugmotorenbau G.m.b.H. has also built another engine with inverted water-cooled cylinders. This other engine is considerably larger and is in the same power class as the 1,200 hp Junkers Junio 211 and Mercedes Benz DB 601. It has not been built in quantities, however, as it is the policy of the German Air Ministry never to have more than two engines of the same type and power output in production.

SPECIFICATIONS

B.M.W. 116 aircraft engine
Type: twelve cylinders, water cooled, 60° inverted vee, geared drive, four cycle
Bore and stroke: 5.12 in. x 5.12 in.
Displacement: 1,267 cu.in.
Length and area: 63.9 in. x 5.2 sq.ft.
Rated output: 600 hp for take-off
600 hp at 11,800 ft.
Total weight (dry): 1,003 lb.
Specific weight: 1.67 lb./hp.
Fuel consumption: 0.50 lb./hp./hr.
Oil consumption: 0.023 lb./hp./hr.
Compression ratio: 6.0:1

Middletown Depot

(Continued from page 33)

They control the work of hundreds of men and are responsible for some $25,000,000 worth of equipment. Responsible to the chief engineer are four assistant engineering officers of the Air Corps and the civilian superintendent of aircraft shops. Under the latter are foremen of the four principal departments: aero repair, engine repair, electrical equipment and accessories, and metal manufacture and repair.

Over 75,000 items of equipment are stored in the huge warehouses at Middletown. These vary from cotter pins to complete engines, from aluminum sheet to complete wings for bombers, from inner tubes to gigantic crash trucks waiting shipment to a new air base. Only by trudging through the miles of warehouses can one appreciate the complexity of a large, modern air force.

An air depot is more than just an overhaul base. It is a source of supply for the endless variety of aviation equipment. Nearly a thousand tons of material a month are shipped out of Middletown, a third of it by air. Nineteen fields depend on this depot for their sustenance. Millions of dollars worth of supplies flow in and out in a never ending stream. Here is an efficient, smoothly operating organization which does much credit to the Air Corps.

Much of the efficiency of our air force today is due to the Air Transport Squadrons which ferry material (and occasional personnel) back and forth between depots and fields. Unknown to the public, and even to most of the aviation industry, the Army has an air freight line which has been operating for years and which is an astounding success. The Air Transport System was originated by Col. Hugh Knerr, now retired, who saw the need for a fast, smoothly operating system for supplying air transportation between all units of the Air Corps. For a number of years a miscellaneous collection of airplanes was used but now Douglas transports are standard equipment. There is not space in this issue to commemorate properly the splendid work of the transport squadrons.

The problems of the depots are only beginning. With the thousands of new airplanes which will be added to the Air Corps maintenance assumes a growing importance. Only if the depots operate smoothly can the Air Corps keep its planes aloft.

Standardization

(Continued from page 118)

clusion of his paper he urges that the twenty or so gaging systems now in use all be displaced by a single decimal system. The number and letter drill sizes should be replaced by sizes based on the decimal system. It is said that a single large user of copper, brass, and aluminum, has estimated that a saving of more than $1,000,000 annually could be made within its organization if a uniform gage system was used.

The author also makes a serious plea for adoption of the metric system. There is a strong possibility that this country will soon be the only one in the world not using the metric system.

In conclusion the author calls attention to the fact that most of the AN standards are airplane standards and many of them are not satisfactory for engine use. For example the nominal size of the I.D. of the hose is the nominal size of the O.D. of the nipple. This combination is causing trouble as the nominal size of the I.D. of the hose must be smaller than the O.D. of the nipple in order to insure a tight connection. It is recommended that new standards be created that are used on engines only, but where parts are used both on engines and airplanes then but one standard should be used.

The money spent on standardization will pay dividends beyond calculation so it is recommended that managements of aircraft and aircraft engine companies encourage their men to serve on S.A.E. standards committees, and facilitate such work in every way possible.

Mitchel Field, N. Y., has a total of 339,311 sq. yds of concrete pavement. Of this, 179,560 sq. yds. are in runways, 35,137 sq. yds. in taxiways, 23,722 sq. yds. in aprons; 100,892 sq. yds. in roadways. Official photograph, 2nd Air Base Squadron Photo Section, GHQ Air Force, U. S. Army.

Concrete runways at Mitchel Field must take the heavy dead load and landing impact of Flying Fortresses like these. Official Photograph, 2nd Air Base Squadron Photo Section, GHQ Air Force, U. S. Army

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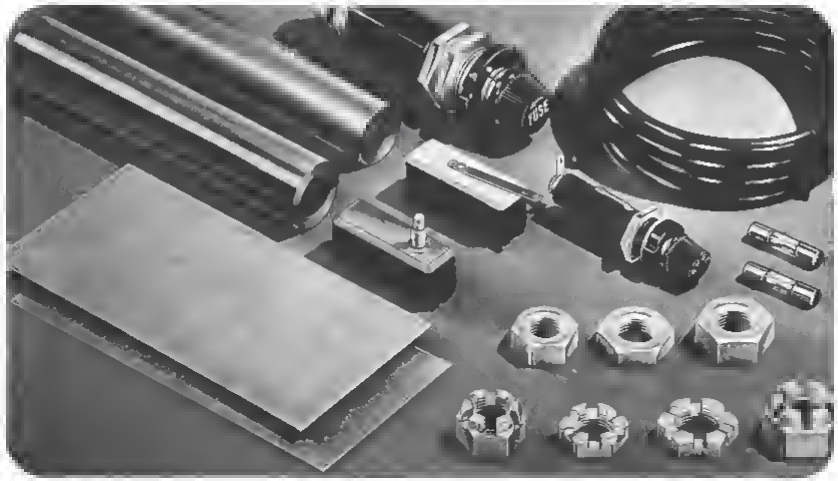

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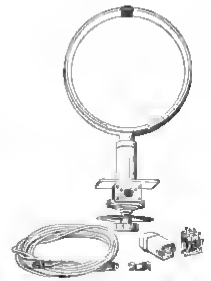

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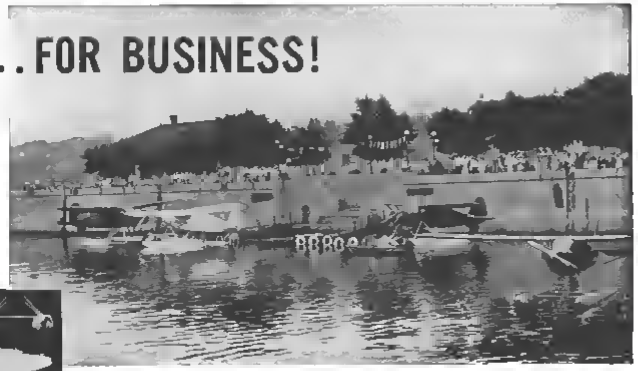

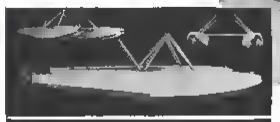

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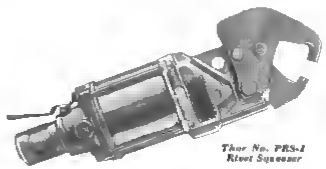

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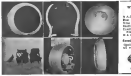

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LUSCOMBE PHANTOM one of the latest. A complete airplane needing no extras, eng in perfect condition Equipment includes all blind flight instruments, 2 yrs 2 way 1 radio primer lights 200 hours on engine 300 hrs on airplane $2,750 cash William C Haines, 500 E Durham St, Philadelphia, Pa

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STINSON SM8A 200 total hours since new "B" gear speed ring, landing lights camera hole Reupholstered and recovered, hand rubbed finish Excellent shape $1100 Springfield Aviation Co, Municipal Airport, Springfield Illinois

STINSON SR9BD, total time 350 hours. Beautiful condition Blue fuselage Yellow wings Complete night equipment Red leather upholstery $6000 Hyannis Airport Corp, Hyannis, Mass

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CUBS Many bargains, 1940 65 H.P. Coupe. Dual Ignition Continental fully equipped $1850 1938 Coupe, 65 H P dual ignition Continental fully equipped, $1650 1939 50 H.P. Continental Coupe, fully equipped $1250 Warner 125 H P Monocoupe, full instruments, perfect, $1825 1940 Trainer, 50 H.P. Franklin, A-1 condition, $1095 New Standard $695 1938 50 H.P. Continental Trainer $650 Travel air OX5 $325 Kitty Hawk $855 All financeable Bennet Air Service Hightstown (Cubtown), New Jersey No 2

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CYLINDER BAKING OVEN: Low cost Automatic time clock Low wattage. Electrically operated. Complete $39 50 Aeronautical Trading Co, Floyd Bennet Airport, Brooklyn N Y No. 5

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SAVES 15 POUNDS IN BEECHCRAFT MODEL

Aircraft designers keenly appreciate the availability of a low-cost domestic supply of magnesium (Mg) metal. Practically all manufacturers of airplanes are now using it in the form of DOWMETAL* Magnesium Alloys, primarily to eliminate weight, for DOWMETAL weighs a full third less than any other metal in common use

In the twin engine Beechcraft Model 18S, for example, designers have saved about 15 pounds in weight by using 26 DOWMETAL sand castings, some made by Dow and some by Eclipse Aviation, Bendix, New Jersey, and eleven DOWMETAL die castings made by the Harvill Aircraft Die Casting Corporation, Los Angeles

The makers of this airplane, Beech Aircraft Corporation, Wichita, Kansas, have been using DOWMETAL for several years. They employ it because DOWMETAL castings are characterized by lightness in sections having sufficient wall thickness to be adequately rigid.

DOWMETAL lends itself readily to the usual methods of fabrication and assembly and is therefore available in sand, die and permanent mold castings, forgings, sheet, strip, plate, bars, tubes, structural and special extruded shapes

Special information pertaining to the use of DOWMETAL in aircraft construction is available on request

THE DOW CHEMICAL COMPANY, MIDLAND, MICH.
Branch Sales Offices: New York City, St. Louis, Chicago, San Francisco, Los Angeles, Seattle
*Trade Mark Reg. U.S. Pat. Off.

DOWMETAL
MAGNESIUM ALLOYS

LIGHTEST OF ALL STRUCTURAL METALS

Aircraft Accessory Equipment

AN ECLIPSE CONTRIBUTION TO National Defense

U. S. AIR CORPS

U. S. NAVY

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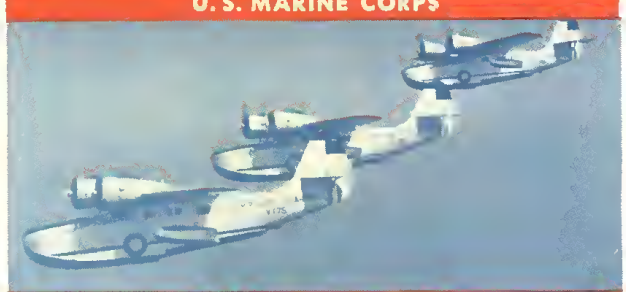

U. S. COAST GUARD

U. S. ARMY

Significant is the fact, that for more than 20 years Eclipse Aviation has pioneered in the development and manufacture of accessory equipment for the United States Military Services.

Whether the need has been for equipment applications on the ground, at sea or in the air, Eclipse products have consistently proven their ability to fulfill the requirements of military service.

We are justifiably proud of this record of dependability, service and progress—and honored too at the part Eclipse Accessory Equipment is playing in the establishment of National Defense Security.

AIRCRAFT ACCESSORY EQUIPMENT UTILIZED BY U. S. MILITARY SERVICES

ENGINE STARTERS: Inertia, Direct Cranking Electric, Combustion, Hand Turning Gears, Combination Direct Cranking Electric and Inertia.

STARTER ACCESSORIES: Battery Booster Coils, Solenoid Switches, Solenoid Engaging Devices, Control Switches, Magnetos, Energizers.

GENERATING EQUIPMENT: Single Voltage Generators, A. C. Alternators, Autosyn Alternators and Dynamotors, Radio Dynamotors, Filter Boxes, Control Panels and Boxes, Cutouts, Relays, Current Regulators.

VACUUM PUMP AND ICE-ELIMINATION EQUIPMENT: Air Valves, De-Icer Control Valves, De-Icer Distributing Valves, Suction Regulating Valves, Suction Relief Valves, Check Valves, Pressure Relief Valves, Oil Separators, Engine Driven Air Pumps, Propeller Anti-Icer Pumps.

HYDRAULIC EQUIPMENT: Engine Driven Hydraulic Pumps, Motor Driven Hydraulic Pumps, Hand Hydraulic Pumps, Hydraulic Remote Control Units.

MISCELLANEOUS ACCESSORY EQUIPMENT: Direct Reading Fuel Flowmeters, Retracting Motors, Supercharger Regulators, Automatic Mixture Controls, Propeller Governor Controls, Engine Synchroscope, Ammunition Rounds Counters and Contactors, Mechanical Engaging Solenoids, Auxiliary Engines, Auxiliary Power Supply Systems, Accessory Gear Boxes.

ECLIPSE AVIATION
DIVISION OF BENDIX AVIATION CORPORATION
BENDIX, NEW JERSEY, U. S. A.